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THE JOURNAL OF APPLIED PSYCHOLOGY

JAMES P. PORTER, *Editor*
OHIO UNIVERSITY ATHENS, OHIO

With a Board of Cooperating Editors

SOME INTERESTING CONTRIBUTIONS IN THIS ISSUE:

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HENRY N. DEWEER. The Relative Recall Effectiveness of Visual and Auditory Presentation of Advertising Material

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THE EFFECT OF ITEM ANALYSIS UPON THE DISCRIMINATIVE POWER OF AN EXAMINATION

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VARIOUS methods are available for evaluating the contribution of individual items to a total examination score in order to eliminate items of little value. In connection with a final examination it occurred to me that it might be of interest to cumulate the items, rejected as a result of an eliminative process, into a total score, and compare it with the total score obtained by cumulating the selected items. The technique of item analysis used for selecting and rejecting items has been described in some detail elsewhere (1). Lentz, Hirshstein and Finch (2) have published an evaluation of the method here used. Zubin (3) has compared the more precise methods of item analysis.

Briefly, the method used consisted of dividing the examinations into three piles, an upper, middle and lower third, on the basis of raw total score. The proportion of correct (or wrong) answers for each third is then computed and those items which, on inspection, are seen to discriminate sharply between the groups are selected for use in subsequent examinations. Those items of little or no discriminative value or those in which either lower group was superior to the upper were rejected. While more refined procedures might be used, from the practical standpoint of speed and a minimum of statistical manipulation this technique works well.

Table I shows the composition of the examinations studied.

The total examination consisted of five types of objective items with a total possible point score of 222, if each correct answer were given a weighting of 1. From this examination 86 items were selected, hereafter called the "good items," on the basis of their power to discriminate between the lower, middle and upper thirds. Eighty-three items lacking such power were selected as "poor items." Fifty-three items occu-

TABLE I

Composition of Examinations Studied

TYPE OF QUESTION	TOTAL EXAM.	GOOD ITEM EXAM.	POOR ITEM EXAM.	OMITTED ITEMS
True False	80	21	39	20
Matching	24	15	7	2
Completion (Blank)	50	30	18	2
Completion (Controlled)	30	14	1	15
Double Multiple Choice	38	6	18	14
Possible Score	222	86	83	(53)
Mean	141.6	50.3	55.3	.....
S.D.	15.5	11.1	3.5	.....

pying an intermediate position were omitted from consideration. After this selection 112 examination blanks were rescored to obtain the total scores for each student on the good items and on the poor items. As the table shows, the distribution of items according to type is not similar in the resulting examinations. While a perfect study would involve the use of examinations of identically the same pattern, the total number of items available for this study did not give enough leeway for such matched examinations. However, the results obtained are not vitiated from the practical standpoint since the question with which we are concerned is that of the discriminative power of the accepted and rejected items as a whole.

The last two lines of the table show the means and the standard deviations of the total scores for the whole examination and of the reduced examinations. The mean score of the poor item examination is 5 points higher than that of the good item examination, while the standard deviation is only one-third as great. The range of the good item examination is 80 points from a low of 100 to a high of 180 while that of the poor item examination is only 19 points from a low of 43 to a high of 62. This restriction of range is undoubtedly the significant factor in the results to be presented.

The pooled good items correlate +.95* with total examina-

* All coefficients presented are Pearsonian product-moments.

tion score, while the pooled poor items have a coefficient of +.45. The intercorrelation between the good and poor items is only +.21. It is to be expected that both the good and poor item examinations will show positive correlations with total score since both contribute to total score. The fact that the reduced examination composed of good items, constituting approximately one-third of the total number of questions, correlates +.95 with total examination score, shows that the good items alone are almost as valuable as the total examination. An error in this comparison arises out of the fact that the group used for the selection of items is also that upon which validation is done. On a second use of these items on a totally different group the relation would not be as high.

This error however does not enter into the series of correlations reported in Table II.

TABLE II

Correlations With Final Grades and With Book Reports

(112 Cases)

	WITH FINAL GRADE	WITH BOOK REPORTS
Book Reports	.80	.....
Good Items	.90	.50
Poor Items	.22	.04
Total Exam.	.89	.45

As part of the winter quarter's work the students wrote three book reports. The readers divided each of these into seven piles on the basis of quality. A sigma score was then assigned to each on the basis of the percentage of individuals falling within each rating class. The sigma scores were averaged to obtain the final grade for the book reports. To this figure was added the sigma score equivalents of the total examination, so as to give it a weighting in computing the final term grade equivalent to that given the combined book reports. The book report grades furnish a measure of the student's ability which is obtained independently of the objective ex-

amination and a criterion against which the results of pooling of good items and of poor items can be checked.

The correlation of total examination score with final grade is +.89, while the coefficient for book reports with final grade is +.80. Each has contributed almost equally. But the coefficient for the good item examination with final grade, which is +.90, and that of the poor item examination which is only +.22, shows that the good items predict final grade practically as well as does the total examination, whereas the poor item possesses such a low predictive value as to be practically valueless.

The second column of the table is particularly interesting. While the total examination correlated +.45 with book report grades, the good items alone correlate +.50 and the poor items only +.04. An examination made up of items which have been selected as discriminative by the criteria already described, results in a higher correlation with an independently obtained series of grades than does the total examination itself and a very much more significant correlation than results from the rejected items. In fact the poor item examination with its zero correlation is worthless so far as the prediction of an outside criterion is concerned. It should be noted that the book reports were graded and the marks recorded before the examination was given. Hence no opportunity existed for any halo effect to operate from the examination scores to the book report grades.

In Table III are presented the correlation coefficients between the total examination, the examination made of good items, and that made up of poor items, with other criteria available in the records of these students.

On the entire group of 112 students scores on the Minnesota College Aptitude Tests (4) which is composed of 480 recognition vocabulary items given prior to University entrance were available. The total examination correlated +.29, the good item examination +.25 and the poor item examination alone +.14, with College Aptitude scores. Although the total examination results in the highest correlation, the pooled good

TABLE III
Correlations With Other Criteria

	COLLEGE APTITUDE	HIGH SCHOOL RANK	IOWA ENGLISH
Cases	112.0	80.0	105.0
Total Exam.	.29	.16	.31
Good Items	.25	.22	.33
Poor Items	.14	.12	.10

items alone show substantially the same correlation, while the pooled poor items are distinctly inferior.

The second column presents results on 80 cases, for which high school rank based on achievement was available. Here the total examination correlated only + .16, the pooled good items + .22 and the pooled poor items + .12. The pooled good items then have a slightly superior predictive value for past achievement than does either the total examination or the pooled poor items.

In the third column correlations of the Iowa English Examination given to University freshmen are presented. Here the total examination and the pooled good items show substantially the same correlation coefficient + .31 and + .33 respectively, while the pooled poor items give only + 10. The good item score predicts Iowa English scores slightly better than does the total examination and substantially better than does the poor item score.

It is clear from Tables II and III that when correlated with outside criteria of a student's success and aptitude, the good item score is as good as or slightly better than the total examination score and is noticeably superior to the poor item score.

So far our concern has been the validity of the good and poor item examination. The data lend themselves to an analysis of the effect of the procedure of eliminating items upon reliability. Reliability coefficients were determined for the total examination, the good item examination, and the poor item examination by the split half (odd-even) method

followed by the use of the Spearman-Brown prophecy formula. The results are found in Table IV.

TABLE IV

Reliability of the Examinations

	RAW RELIABILITY SPLIT-HALF	SPEARMAN-BROWN FOR WHOLE	SPEARMAN-BROWN FOR 222 ITEMS
Total examination (222 items)	+.761	+.864	+.864
Good item examination (86 items)	+.713	+.832	+.928
Poor item examination (83 items)	+.056	+.106	+.241

Although the poor item examination is so unreliable as to possess no value whatever, the good item examination shows reliability coefficients which closely approximate those of the total examination. Since the total examination contains 222 items while the good item examination contains 86 items and the poor examination 83 items it is appropriate to inquire what the reliability of the reduced examinations would be if they contained 222 items. These coefficients which can also be calculated with the Spearman-Brown prophecy formula are presented in the third column of Table IV. The resulting coefficient for the good item examination is noticeably higher than that for the total examination, while that for the poor examination though increased is still so low as to indicate its lack of value.

One might well raise the question whether or not this use of the Spearman-Brown prophecy formula is justified, not on statistical grounds, but on the ground that the number of good items that can be obtained is limited rather than infinite. Would it be possible to secure an examination consisting of 222 items, all of which were equal in discriminative power to the 86 here studied? Although so far as the content of a college course is concerned, one may say that such an outcome is well within the limits of possibility, no direct evidence is available. Sometimes this formula has been used to predict a final outcome of the development of measurement techniques

where no such possibilities exist. Undue weight should not therefore be given the last column of this table.

From our results, it is clear that the use of the item analysis technique operated to produce a reduced examination which possessed equal or slightly greater validity than the total examination and almost as great reliability. If a good item examination of the same length could be produced, it would possess great reliability, and very likely, though we are not in a position from our data to answer the question, still greater validity.

Our data taken as a whole indicate that an objective examination is a miscellaneous collection of items, each of which possesses a different value for discriminating individual abili.y or accomplishment. If those of high discriminative value are separated out and pooled into a total score, the resultant score will have a lower mean, a higher standard deviation, higher correlations with both total score and outside criteria, and higher reliability coefficients by the split half method than will the pooled scores of the items of low discriminative value. The question may well be raised as to the interrelation of these measures of the pooled scores. Obviously the higher correlation coefficients are a function of the increased range, and the low coefficients are a function of the decreased range of the good and poor pooled scores respectively. What of the load carried by each of the total examination? Since good item score correlates + .95 with total examination scores and since poor item score correlated only + .45 with total examination score and since the standard deviations are 15.5 for total examination, 11.1 for good items and 3.5 for poor items, it is evident that even in the total examination the good items are carrying the major part of the discriminative load. On the poor items the responses of all students are distributed closely about the mean and have little or no effect on the outcome except as they distort the ratings in individual cases.

Summary and Conclusions

1. A comparison is made of the predictive value of a score based on items selected and a score based on items eliminated,

from an examination on the basis of their value in discriminating between the upper, middle and lower thirds of a college class, when total examination score was used for division into groups.

2. The score on the good item examination predicts total examination score with high accuracy, and predicts final grade, book report grade (an independent criterion), high school rank, and Iowa English score better than does the total examination. It predicts College aptitude almost as well.

3. The score of the poor item examination predicts total score poorly, has no relation to book report grades, and shows much lower correlations with College aptitude, high school rank and Iowa English, than either the total examination score or the good item examination score.

4. The effect of item analysis in this instance was the production of an examination which had almost as great reliability as the total examination, and which if it possessed the same number of items would have had noticeably greater reliability. The poor item examination possesses little or no reliability.

5. In this instance the result of the item analysis was the production of an examination approximately one-third the length of the original examination, which, on the basis of all the criteria available, is equal to or superior to the original total examination. Eliminated items have little or no value, either individually or when pooled.

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THE RELATIVE RECALL EFFECTIVENESS OF VISUAL AND AUDITORY PRESENTATION OF ADVERTISING MATERIAL

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PREVIOUS to 1932 when this investigation was begun there had been no attempt made to compare directly the effectiveness of the visual and the auditory advertising media. The present experiment was designed, therefore, to make this long needed comparison. Although much work has been done comparing visual and auditory presentation of learning material, the results have been ambiguous due, perhaps, to differences in the memorizing materials used and to variations in the task assigned to the subjects. In planning the experimental procedure for this study an effort was made to eliminate all possible uncontrollable variables in order to get at the more fundamental problem of the relative effectiveness of visual and auditory presentation of advertising material as such. For this reason the visual material was presented to the subjects without illustrations and the auditory copy was presented by means of a radio loudspeaker without the usual accompanying program of radio entertainment.

MATERIALS

The advertising material consisted of thirty advertisements, fifteen for each medium, formulated by the experimenter after study of many magazine and radio advertisements. An attempt was made to equalize the length and difficulty of all advertisements by making each one from seventy to eighty words in length, by having the trade names appear three

[1] This study was conducted at the University of North Carolina and the author wishes to acknowledge his indebtedness to the Department of Psychology of that University for the privileges accorded him in this research, and especially to Dr. Harry W. Crane for his assistance in criticizing the work as it progressed.

times in each advertisement, and by using fictitious two-syllable trade names printed in bold face caps for the visual presentation, and spelled out once for the auditory presentation. Advertisements of fewer than seventy words are difficult to formulate, while those of more than eighty words would have consumed more time than was at the experimenter's disposal. The factor of fatigue might have also entered in to complicate the results if longer advertisements had been used. The trade names were placed at the beginning, near the middle, and at the end of each advertisement since this arrangement was found to be typical in advertisements of this length. Fictitious trade names were used in order to rule out the possible unequal effects of familiarity with standard trade names; and they were carefully selected so that they would not even suggest the standard names. A preliminary study showed that subjects were usually unable to spell names correctly unless they either were seen or were spelled for them at least once. To equalize the effect of spelling in the auditory presentation, the bold face caps were used in the visual. After much preliminary study fourteen point Century type was chosen for use in the visual presentation since this was found to be easily legible when the material was placed on the table at a distance of approximately fifteen inches from the subject's eyes. The products to be used were arbitrarily selected by the experimenter and were, with two exceptions, the same in both presentations; but, of course, the verbal contents of the advertisements in each medium were different.[2]

The trade names were proper names taken from the directory of the American Psychological Association, modified in some cases to make them easier to pronounce, and selected

[2] Advertisements for wrist watches and dog medicine were used in the auditory presentation instead of the advertisements for alarm clocks and dog food which were used in the visual presentation. This change was made to determine whether a slight change in the product as well as in the trade name would affect the recall. The results show that this change had no significant effect on the subject's ability to recall the advertisements. Copies of these advertisements may be obtained by addressing the author at the University of Rochester, Rochester, N. Y.

carefully in order to insure against recognition by the subjects. The following is a list of the products and trade names selected for use in the experiment:

Visual Presentation	*Auditory Presentation*
Gillman Motor Oil	Upton Motor Oil
Elder Cosmetics	Florenz Cosmetics
Stanton Storage Battery	Latshaw Storage Battery
Lumley Toothpaste	Harlow Toothpaste
Quincy Alarm Clock	Anders Wrist Watch
Wagner Coffee	Harvey Coffee
Irwin Radio	Richmond Radio
Newland Soup	Welker Soup
Owens Cigarettes	Ellwood Cigarettes
Crandall Automobile	Bregman Automobile
Frandsen Dog Food	Dearborn Dog Medicine
Zigler Shaving Cream	Abbott Shaving Cream
Dorman Hair Tonic	Feldman Hair Tonic
Tilton Cereal	Lugoff Cereal
Shipley Tobacco	Langford Tobacco

The visual stimuli were presented in a booklet which was 8½ inches long by 5½ inches wide, the inside stock being Suede Wove sixty-pound white paper and the cover American Embossed ninety-pound lawn-green paper. It contained sixty-four pages, fifteen printed and forty-nine blank, with one blank sheet (three pages) between each printed page. The type used for the advertising copy was fourteen point linotype Century expanded, set thirty ems long with the trade names in bold face caps. The outside covers were plain except for the word "FRONT" printed on the front cover. The whole booklet was printed in sixteen page signatures. The auditory stimuli were presented by the experimenter by means of a microphone and loudspeaker system, the microphone being placed in a room some distance from the radio which was connected to it. A Silver Marshall radio, console model, with dynamic speaker attached to a Universal Model A single-button microphone was used.

PROCEDURE

A group of seventy-three subjects were divided into two groups of thirty-six and thirty-seven students each by taking

alternate names from an alphabetical list of students in the elementary psychology class. In series I group A participated in the visual part of the experiment, while Group B participated in the auditory part. In series II the two groups were reversed so that Group A participated in the auditory part while Group B was participating in the visual. In series III, conducted five months after series II, the entire group of seventy-three students was given an opportunity to recall advertisements presented in both media.

The two groups assembled at the beginning of the regular class period and were told that a memory experiment was to be conducted as part of the regular laboratory work and each student was asked to follow directions carefully so that data could be obtained which would be of value as experimental confirmation of principles given in the lecture part of the course.

Group A was then sent to a laboratory in another part of the building where the following instructions were given:

> "The monitors will pass out some booklets face up on the table before you. Do not touch these booklets, but look at them to make sure that the cover facing you has the word 'FRONT' printed on the upper left-hand corner. If not, turn the booklet over. This booklet contains a series of advertisements for familiar products. You are to read them carefully as later you will be asked to reproduce them for me. When I give the signal you are to turn back the front cover and expose the first page which is blank. All right, turn back the front cover. Now slip your finger under the upper right-hand corner of this page so that when I give the signal, not now, you can turn the page quickly and begin to read the material which is printed on the next right-hand page. Read at your normal rate but do not read any part of the material more than once. When you have finished reading, turn the page immediately to the next blank page and wait until I give the signal to go on to the next advertisement. While you are waiting for the signal, think about the advertisement you have just finished reading. Remember, you will be called upon later to state the content of each advertisement. Are there any questions? All ready, turn the page to the first advertisement, carefully

read it through once, turn to the next blank page and wait for the next signal."[3]

After exactly one minute the signal was given to turn the page to the next advertisement. This procedure was repeated until all fifteen advertisements had been read by the subjects. The booklets were then collected and blank forms were distributed for the recall of the material which had just been presented. The subjects were asked to fill in Form 1 first and then to go on immediately to Form 2. However, they were allowed to return to Form 1 if their work on Form 2 suggested additional data which belonged on Form 1. The directions printed on the top of Form 1 were as follows:

"Write down, as quickly as possible, all the products you recall as having been advertised in this experiment, *in the order in which you recall them.* Try to recall both the name of the product and its trade name, *e.g.*, not just flypaper, but Tanglefoot flypaper. If you can't do this, then indicate just the trade name or the name of the product as the case may be, in the proper column. Remember, list them in the order of recall, don't give up too quickly, and keep your eyes on your own paper at all times. A sample response is given below."

Directions at the top of Form 2 were as follows:

"Go back over the list you have just completed and for each product you have recalled write all you can recall about the content of the advertisement. Number your accounts as they are numbered in your recall list and draw a line across the page to separate one account from another. Use both sides of this sheet. The monitors will furnish additional sheets as they are needed. Please write plainly."

The remainder of the class hour, approximately thirty minutes, was allowed for this part of the experiment and the subjects were then told that the experiment was concluded and that class results would be posted at a later date.

[3] Since it seemed quite probable that most of the subjects would assume that they would later be asked to recall the material, it was thought best to make the conditions the same for all subjects by informing them that they would be called upon to reproduce the content of each advertisement. Five monitors were stationed in the room to see that the directions were followed.

Group B remained in the lecture room and was given the following instructions:

> "You will hear a series of advertisements for familiar products. You are to sit comfortably and listen carefully to these because later you will be called upon to reproduce the contents of them. Between each advertisement there will be a brief pause during which you are to think about the content of the advertisement you have just heard. Remember, listen carefully and make no unnecessary noise lest you disturb your neighbor. There will be an initial practice period during which you may change your seat if you have any difficulty in hearing the speaker. Are there any questions?"

The experimenter, located in another room, then read a short prose selection into the microphone in order to prepare the subjects for the advertising material which was to follow and also to allow time for students who could not hear well to change to better seats. At the conclusion of this selection the announcer cautioned the subjects to listen carefully and then read the first advertisement. Before each advertisement the announcer said, "Ready," waited two seconds and then read the advertisement at a rate calculated to complete the reading in forty-five seconds. There was an interval of fifteen seconds between each advertisement. At the close of the presentation period, forms similar to those used for Group A were distributed and from this point on the procedure was identical with that used for the visual group.

On the following day Forms 1 and 2 were again distributed to both groups and a second recall period of thirty minutes' duration was given. A third recall was given on the fifth day under similar conditions. Hereafter the first recall will be designated as "immediate recall," the second, "24-hour recall," and the third, "120-hour recall."

Three days after the 120-hour recall period of Series I the whole experiment was repeated with Groups A and B reversed, Group A attending the auditory presentation and Group B the visual. Hereafter this will be referred to as Series II. The procedure used in Series II was identical with that used in Series I with the single exception that because of

conflicting events the third recall period of Series II was held on the eighth instead of the fifth day and came during the examination period. This will henceforth be referred to as "168-hour recall." Seventy students participated in Series II.

Series III was given some five months after Series II and differed somewhat as to procedure. The subjects had all completed their psychology course and many of them had left school. Those still remaining on the campus were given a form to fill out while a form, together with a letter of instructions, was sent to each subject who was no longer in school. On this form were listed the names of the products in the left column and space was left to record the trade names on the right. The products were listed because it was found that after five months delay the number of trade name recalls was too greatly diminished by the inability of the subjects to recall the products themselves. In all, data were obtained from sixty-five of the seventy subjects who had participated in Series I and II.

ANALYSIS OF CORRECT RECALLS

The first step in comparing the effectiveness of the two advertising media is an analysis of the cases in which the products and their trade names were recalled correctly by the subjects in each group. The data obtained from each subject were carefully checked and the correct recalls recorded.[4]

From these records a comparison was made between the auditory and visual groups of the number of correct recalls for each advertisement in the various parts of the experiment. Tables I, II, and III present these comparisons for the two groups of subjects in all three series.

In these tables the products are listed in the order of presentation in the first column. Where two different products are listed on the same line, the first appeared in the visual

[4] Copies of the tables showing the individual recalls for Series I, II and III may be found in Appendix C of the author's doctoral dissertation which is on file in the Library of the University of North Carolina. The raw data sheets are on file in the Department of Psychology of the University of North Carolina.

TABLE I

A Comparison of the Number of Correct Recalls of Products and Trade Names for the Visual and Auditory Groups in Series I

PRODUCTS	VISUAL GROUP			AUDITORY GROUP		
	1st Recall	2nd Recall	3rd Recall	1st Recall	2nd Recall	3rd Recall
Motor Oil	17	19	16	28	26	29
Cosmetics	22	20	17	24	22	23
Storage Battery	15	13	9	8	7	7
Toothpaste	9	7	3	13	12	15
Alarm Clock (Watch)	11	13	9	15	17	12
Coffee	8	7	3	14	14	15
Radio	13	14	11	26	27	26
Soup	7	3	2	7	7	8
Cigarettes	19	19	17	19	18	23
Automobile	12	13	12	15	13	13
Dog Food (Dog Medicine)	9	9	5	12	10	11
Shaving Cream	14	11	8	14	12	12
Hair Tonic	7	7	5	5	4	7
Cereal	9	6	6	12	9	9
Tobacco	22	18	18	8	7	10
Total Number Correct	194	179	141	220	205	220
Percent Correct	35.9	33.1	26.1	39.6	36.9	39.6
% Loss from 1st Recall		7.7	27.3		6.8	0.0

TABLE II

A Comparison of the Number of Correct Recalls of Products and Trade Names for the Visual and Auditory Groups in Series II

PRODUCTS	VISUAL GROUP			AUDITORY GROUP		
	1st Recall	2nd Recall	3rd Recall	1st Recall	2nd Recall	3rd Recall
Motor Oil	25	22	10	27	23	21
Cosmetics	19	14	11	21	17	13
Storage Battery	22	18	9	13	10	11
Toothpaste	14	12	6	22	21	20
Alarm Clock (Watch)	15	14	10	21	21	14
Coffee	12	9	4	16	17	13
Radio	21	21	14	24	26	24
Soup	11	11	8	6	7	4
Cigarettes	21	21	15	25	21	18
Automobile	17	16	15	14	11	11
Dog Food (Dog Medicine)	17	13	10	20	19	17
Shaving Cream	20	10	6	14	10	10
Hair Tonic	15	11	8	12	9	6
Cereal	15	8	2	7	6	3
Tobacco	29	23	22	20	7	7
Total Number Correct	271	223	150	262	225	192
Percent Correct	50.2	41.3	27.8	51.4	44.1	37.7
% Less from 1st Recall		17.7	44.7		14.1	26.7

TABLE III

A Comparison of the Number of Correct Recalls of Trade Names by the Visual and Auditory Groups in Series III

PRODUCTS	VISUAL	AUDITORY
Motor Oil	7	25
Cosmetics	1	10
Storage Battery	5	8
Toothpaste	1	17
Alarm Clock (Watch)	3	14
Coffee	1	7
Radio	7	26
Soup	2	8
Cigarettes	5	19
Automobile	3	11
Dog Food (Dog Medicine)	2	8
Shaving Cream	2	12
Hair Tonic	2	8
Cereal	2	6
Tobacco	12	10
Total Number Correct	55	189
Percent Correct	5.6	19.4
% Loss from 1st Recall	86.9	55.8

presentation only, while the second appeared only in the auditory presentation. For an item to be listed as a correct recall in these tables the trade name must have been spelled either correctly or phonetically. The results are recorded in three separate tables since the three series cannot be directly compared because they were not given under similar conditions. In Series II all the subjects had previously had an opportunity to learn the list of products in Series I, and that this aided the subjects in learning Series II is shown by the greater number of correct recalls for almost every product in the later series, especially in the case of Group B.

In Series I it will be noted that there was a total of 194 correct recalls out of a possible 540 (number of subjects multiplied by the number of advertisements) immediately after the visual presentation of the advertisement. With the auditory presentation there were 220 correct recalls out of a possible 555. Thus, the visual group recalled 35.9 per cent of the advertisements correctly, while the auditory group recalled 39.6 per cent. Twenty-four hours later the visual group dropped to 33.1 per cent, a loss of 7.7 per cent from the first day, while the auditory group, losing 6.8 per cent,

recalled 36.9 per cent. After 120 hours the visual group, recalling 26.1 per cent of the material, showed a loss of 27.3 per cent from the first recall, while the auditory group, correctly recalling 39.6 per cent of the material, showed no loss from the first day and actually gained slightly over the twenty-four hour recall. The reliability of these differences as shown by the critical ratios given in Table IV are .79, 1.70 and 3.03 respectively.

TABLE IV

Table Showing the Reliability of the Difference Between Visual and Auditory Average Recalls in Series I, II, and III

		GROUP	NUMBER OF CASES	MEAN SCORE	STANDARD DEVIATION	$SIGMA_{diff.}$	$\frac{D}{SIGMA_{diff.}}$	CHANCES IN 100
SERIES I	Immediate Recall	V	36	5.39	3.07	.710	.79	77
		A	37	5.95	3.00			
	24-Hour Recall	V	36	4.42	2.98	.663	1.70	96
		A	37	5.54	2.64			
	120-Hour Recall	V	36	3.64	2.55	.691	3.03	100
		A	37	5.95	3.03			
SERIES II	Immediate Recall	V	36	7.53	3.32	.833	.22	58
		A	34	7.70	3.17			
	24-Hour Recall	V	36	6.39	3.64	.794	.29	61
		A	34	6.62	3.09			
	168-Hour Recall	V	36	4.17	3.05	.728	2.05	98
		A	34	5.65	3.18			
SERIES III	5-Month Recall	V	65	.76	1.62	.703	1.88	97
		A	65	2.08	1.55			

In Series II the results were, in general, similar to those obtained in Series I. The recalls, as previously noted, were more numerous because the subjects had already learned many of the products and were familiar with the procedure of the experiment. Both groups showed a higher rate of forgetting, the visual group losing 17.7 per cent and 44.7 per cent for the second and third recalls respectively, while the

auditory group lost 14.1 and 26.7 per cent respectively. The relatively great loss shown by the two groups in the third recall of Series II as compared with that shown in Series I is to be explained, perhaps, by the longer period of delay between recalls, 168 hours as compared with 120 hours, and also by the fact that the third recall of Series II was given immediately after the subjects had completed the psychology final examination and while they were still preparing to take examinations in other subjects. Since these conditions presumably affected members of each group alike, comparisons within the series should be valid. The reliability of the differences in the number of correct recalls by the two groups as expressed by the critical ratios were, as shown by table IV, .22, .29, and 1.88 respectively.

In Series III, conducted some five months after Series II, and including sixty-five of the seventy-three subjects who participated in Series I, only 55 of a possible 975 correct recalls were made by the visual group, while 189 of a possible 975 correct recalls were made by the auditory group. This indicates that the visual group recalled but 5.6 per cent of the advertisements correctly, while the auditory group recalled 19.4 per cent. Correcting for students who participated in Series I but not in Series III, this indicates a loss of 86.9 per cent from the first recall for the visual advertisements and a loss of 55.8 per cent for the auditory advertisements.[5]

The determination of the reliability of the differences between these visual and auditory recalls in the three series by the method of critical ratios is valid only if the conditions of the experiment are such that the differences are true differences between visual and auditory presentations and not merely expressions of other uncontrolled variables such as inequality of the two groups of subjects or lists of advertisements of unequal difficulty.

[5] The first recalls of Series I and II were combined and the scores obtained by subjects not participating in Series III were subtracted from this total in order to make the total number of correct recalls for the first recalls comparable to the correct recalls in Series III.

The method of selecting the members of each group, by taking alternate names from an alphabetical list, should, in a group of this size, insure an equal distribution of the subjects in regard to general recall ability. This is shown to be true by the fact that the auditory group was superior to the visual group in both Series I and Series II.

There are no experimental data to prove definitely that the two sets of advertisements are of equal difficulty. The trade names were, however, all chosen first and then paired off with the various products by modified chance method; and no advertisement was assigned to either the visual or the auditory group until both trade names had been selected, and then they were assigned by chance. Through this procedure the experimenter hoped to make the lists of equal difficulty even though the advertisements within the lists were not of equal difficulty. The best evidence available to show that the two sets of advertisements were actually of equal difficulty is to be found in the results which show that there is no significant difference between the visual and the auditory groups in the total number of immediate recalls in either Series I or Series II, while marked differences do occur in later recalls.

Any uncertainty concerning the equality of the two sets of advertisements affects primarily the interpretation of the results for immediate recall, and has but little effect on the results for the delayed recalls since there is no significant difference between the two media at the time of the first recall period.

Assuming, then, that differences found as stated above represent true differences in effectiveness of the two advertising media, the reliability of these differences can be seen in Table IV. In this table the letters "V" and "A" represent "Visual Group" and "Auditory Group" respectively. The last column of the table shows the number of chances in 100 that the obtained differences are greater than zero. From this column it can be seen that the chances of these differences being greater than zero range from 58 in 100 for immediate recall, Series II, to 100 in 100 for 120-hour recall, Series I

All of the differences favor the auditory presentation. For immediate recall, however, the differences are not sufficiently greater than chance to be of any value. This is also true of the difference obtained in the 24-hour recall of Series II.

ANALYSIS OF PARTIALLY CORRECT RECALLS AND CONFUSIONS

If a complete picture of the effectiveness of the two modes of presentation is to be obtained, partially correct recalls and confusions must also be taken into consideration. The individual data sheets were examined and errors divided into seven different types, namely, (1) product correct—trade name wrong but somewhat similar to the correct trade name; (2) product correct—trade name wrong and not at all similar to the correct trade name; (3) product correct—trade name omitted; (4) trade name correct—product wrong; (5) trade name correct—product omitted; (6) trade name wrong—product wrong but either the product or the trade name somewhat like the correct one; (7) confusions.

Partially Correct Recalls of Type 1:

From the viewpoint of advertising usefulness this is the only type of partially correct recall which would be of any value since the other types could not possibly result in a sale of any of the brands of products used in the experiment. All wrong trade names which seemed to be close enough to the correct trade name in spelling or in pronunciation so that merchants selling these brands could identify them even though the names were somewhat inaccurate were included in this type of partially correct responses. In the visual group there were but 37 cases which might be classified as belonging to this type. These were distributed rather evenly over the three recall periods of each series, the greatest number in any one of the six recall periods being 11. In the auditory group there were only 20 such cases and these too were evenly distributed. Thus, even were all recalls of this type classified as correct recalls and added to the results previously noted, there would be no significant change made in these results.

Partially Correct Recalls of Type 2:

The recalls of this type, where the trade name was not at all like the correct trade name, were more numerous than those of Type 1. In the visual groups there were a total of 254 recalls of this type while in the auditory groups there were 165. These were distributed rather uniformly over the six recall periods of Series I and II.

There were 52 cases of this type in series III but since the subjects were not asked to differentiate between visual and auditory presentations, they cannot be divided into these two classes. They were distributed rather uniformly over the fifteen different products except for batteries and tobacco. Both of these products show a large number of this type of partially correct recall, indicating that one or both of the trade names of each of these products was difficult to recall accurately.

Partially Correct Recalls of Type 3:

Most of the partially correct recalls are of this type where the product is recalled but the trade name forgotten. This would indicate that products are recalled more often than are trade names, a result which is easily explained by the fact that all the products used were familiar to the subjects. There were 1067 recalls of this type in the visual groups and 1003 in the auditory.

Partially Correct Recalls of Type 4:

Cases of partially correct recalls of the type in which a correct trade name was used with the wrong product, *i.e.*, with a product which was not used in the experiment, were few in number, there being but 5 for the visual groups and 19 for the auditory. It is interesting to note that in half of these cases the trade names for motor oil were used with other products. No reason for this confusion is apparent to the experimenter.

Partially Correct Recalls of Type 5:

Type 5 includes all cases where a correct trade name was recalled but was not assigned to any product. There were 41

such cases in each of the two groups, visual and auditory. Most of these occurred in Series I, probably because the subjects had a better command of the list of products with which to use trade names in Series II, having already seen them in Series I.

Partially Correct Recalls of Type 6:

To be included in Type 6 a recall, though wrong as to both product and trade name, must have had an element of correctness by having either the product or the trade name somewhat similar to the correct one. The number of these cases was naturally small, there being but 9 in the visual groups and 4 in the auditory.

Confusions:

The confusions which occur in this type of experiment may be divided into two main types, namely, cases in which a correct trade name was used with some advertised product other than the correct one, and cases in which the trade name used in one medium was used in place of the trade name in the other medium. It can readily be seen that a confusion of the first type would be of no value to the advertiser, while a confusion of the second type not only would be of no value to the advertiser but might even aid his competitor.

There were 68 confusions of the first type made by the visual groups and also 68 cases made by the auditory groups. These were divided almost equally between the two series but were more numerous in the first recall period of each series than they were in the later recall periods.

Confusions of the second type where a trade name used in one medium of presentation was used with a product in the other medium are less numerous than confusions within the series but they have greater significance in an experiment of this kind. There were 27 confusions of this type, 11 in the visual and 16 in the auditory groups. An analysis of these confusions showed that 19 of these 27 confusions were of the type in which a trade name used with a certain product in one advertising medium was confused with the trade name of the same product in the other medium. This type of con-

fusion would actually aid the advertiser's competitor. It is interesting to note that all eleven confusions which occurred in the visual groups were of this more serious type while only half of the auditory groups' confusions were of this type.

In concluding a discussion of all types of confusions attention should be called to the relatively small number of recalls of this type. They are distributed rather uniformly over the three recall periods of each series and, therefore, the only general conclusion that might be drawn is that confusions tend to be greater after a delay between presentation and recall than they are if recall is immediate. This confusion, however, does not necessarily increase with the increase in the length of the delay period.

AN ANALYSIS OF IDEAS RECALLED

An advertiser is not content with having the name of his product only remembered by the potential consumer. He also wishes the consumer to remember the qualities which he believes make his brand superior to all others so that when a purchase of this particular product is to be made his brand will be the favored one. The question then arises: other things being equal, is one medium of presentation superior to another for this purpose?

To answer this question for visual and auditory presentation of advertising material it was necessary to score the number of ideas recalled by each subject for each advertisement. The method adopted was as follows: The experimenter began scoring one set of the advertisements by assigning a value of one idea to each general idea expressed in the copy. As the scoring continued, these general ideas were broken down into more specific ideas whenever it was found that small fractions of ideas were necessary to make the scoring accurate. For example, the statement that Gillman Oil has staying power that defies heat and speed was at first considered to express but one idea. It was soon found, however, that many subjects recalled the first part of this statement only, while others recalled only the second part, thus indi-

cating that, for these subjects at least, this statement really contained two ideas instead of one. It was therefore broken down into two ideas. After enough changes of this sort has been made to insure accurate scoring without the use of small fractions, the whole set of advertisements was re-scored on this new basis. Using this method, each advertisement was divided into approximately ten ideas. Since the advertisements were originally formulated with the idea of keeping the contents equal in recall value, there was little variation in the number of ideas expressed in them. Some advertisements did, however, contain as few as eight ideas and others as many as twelve, and the visual set as a whole contained 154 ideas and the auditory set 148. Since this difference was small, the two sets were considered equal as regards number of ideas contained in the advertisements. Comparisons between individual products, however, should be avoided since a difference of one or two ideas in such a small number as ten would make a significant difference in the two advertisements.

The results for Series I are not included in the following summary because preliminary procedure on the first day of the experiment consumed so much time that the first recall period was not sufficiently long to enable the subjects to record the contents of all the advertisements they recalled.

The results, showing the number of ideas correctly recalled by members of each group, are presented in Table V. This table is similar in construction to that used for showing correct recalls of products and their trade names and is to be read in the same manner.

Table V indicates that at the time of the first recall period, immediately after the presentation of the advertising copy, the visual group as a whole was able to recall 686 ideas while the auditory group recalled 820½ ideas. Twenty-four hours later, the visual group recalled 560½ ideas, a loss of 18.3 per cent from the first recall, while the auditory group recalled 576 ideas, a loss of 29.8 per cent. Thus, although the auditory group shows a 11.5 per cent greater loss, it recalled 15½ more

TABLE V

A Comparison of the Number and Distribution of Correct Ideas for the Visual and Auditory Groups in Series II

PRODUCTS	VISUAL GROUP			AUDITORY GROUP		
	1st Recall	2nd Recall	3rd Recall	1st Recall	2nd Recall	3rd Recall
Motor Oil	53.5	45.0	25.0	89.5	67.5	47.5
Cosmetics	48.0	35.0	27.5	48.5	27.5	19.5
Storage Battery	55.5	40.5	24.5	48.0	36.5	30.5
Toothpaste	38.0	33.0	13.5	55.5	43.0	32.5
Alarm Clock (Watch)	56.5	38.5	22.5	67.0	44.0	44.0
Coffee	35.5	26.0	18.0	49.0	43.0	31.5
Radio	60.0	44.5	30.0	62.0	49.0	44.5
Soup	27.0	22.0	15.0	36.0	21.5	17.5
Cigarettes	67.5	54.5	33.0	75.0	49.5	54.0
Automobile	48.0	36.5	23.5	53.5	41.5	35.5
Dog Food (Dog Medicine)	69.0	51.5	35.5	49.0	38.5	24.5
Shaving Cream	42.0	29.5	22.0	48.0	32.5	28.0
Hair Tonic	39.5	27.0	17.0	41.5	28.0	30.5
Cereal	43.5	30.5	19.0	44.5	26.5	25.5
Tobacco	57.5	46.5	33.5	53.5	27.5	26.0
Total Number Correct	686.0	560.5	358.5	820.5	576.0	491.5
Percent Correct	12.4	10.1	6.5	16.3	11.4	9.8
% Loss From 1st Recall		18.3	47.7		29.8	40.1

ideas than the visual group even though there were only 34 subjects in this group as compared to 36 in the visual group. After 168 hours the visual group was able to recall only 358½ ideas, while the auditory group recalled 491½ ideas. This represents a loss of 47.7 per cent from the first recall for the visual group and a loss of 40.1 per cent for the auditory group.

On the assumption that the contents of the advertisements in the visual and auditory presentations were of equal difficulty, and that any differences found are true differences between visual and auditory presentation as such, we may determine the reliability of these differences statistically in terms of the critical ratio. Table VI shows the reliability of these differences in the number of ideas recalled by each group in each recall of Series II. It will be noted that the critical ratios for immediate recall, 24-hour recall, and 168-hour recall are 2.93, 1.03, and 2.70 respectively. In terms of chances in 100 of these differences being true differences, it

TABLE VI

Table Showing the Reliability of the Difference Between Visual and Auditory Average Recalls in Series II

	GROUP	NUMBER OF CASES	MEAN SCORE	STANDARD DEVIATION	$SIGMA_{diff.}$	$\frac{D}{SIGMA_{diff.}}$	CHANCES IN 100
Immediate Recall	V	36	19.17	7.29	1.69	2.93	100
	A	34	24.13	6.88			
24-Hour Recall	V	36	15.57	5.64	1.33	1.03	84
	A	34	16.94	5.50			
168-Hour Recall	V	36	9.96	6.88	1.67	2.70	100
	A	34	14.46	7.09			

should be noted that for immediate recall it is 100 in 100, for 24-hour recall it is 84 in 100, and for 168-hour recall it is again 100 in 100.

These results indicate that immediately following the presentation of advertising material the auditory group is definitely superior to the visual group in ability to recall ideas which have been expressed in the advertisements. During the first 24 hours after the presentation, the rate of forgetting of the auditory group is greater than that of the visual group, and although the auditory group remains superior to the visual, the difference is not a statistically reliable one. If the delay period is extended to 168 hours, however, it is found that the rate of forgetting of the visual group is faster than for the auditory group and the superiority of the latter group is again statistically reliable.

CONCLUSIONS

The following conclusions should not be regarded as broad generalizations since further standardization of technique may require some slight revisions. They are based upon the performance of some seventy college students under the conditions stated and may possibly not be valid for other groups of subjects or for other methods of presentation.

1. Auditory presentation of advertising copy is distinctly superior to visual presentation when the problem involved is the recall of products and their trade names after a delay of from five days to five months.

2. Auditory presentation is slightly superior to visual presentation after a delay of only 24 hours when the same problem is involved. The superiority is especially noticeable if the subjects are participating in the experiment for the first time (Series I).

3. When the problem is one of immediate recall of products and their trade names, auditory and visual presentation appear to be nearly equal in effectiveness. Any difference found, however, tends to be in favor of the auditory presentation.

4. With visual presentation, the number of advertisements recalled decreases steadily as the time between presentation and recall is increased, while with the auditory presentation there is practically no loss up to 120 hours. After that, the loss is great but in no case does it equal the loss shown after visual presentation.

5. Partially correct recalls of products and their trade names and confusions between trade names occur as frequently with one medium of presentation as with the other, and therefore may be neglected in a study of the relative recall values of visual and auditory presentation.

6. When the problem involved is the recall of ideas expressed in the copy of the advertisement, auditory presentation is distinctly superior to visual presentation. This superiority is not marked after a delay of 24 hours between the presentation and the recall, but it is very marked with immediate recall or recall after a delay of 168 hours.

INDUSTRIAL PSYCHOLOGY IN THE SOVIET UNION*

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. . . life posed the problems, which had to be answered at a time when theory could not keep step with practical research.'' (Spielrein, 1922.)

INDUSTRIALLY pre-war Russia was a backward country. There was little technical development of 180 million people in a land covering one-sixth of the world surface. From 1923 to 1931 the number of employed workers increased 167.3 per cent. Millions of workers had to be drawn from agriculture and fitted into industrial jobs (21, 38, 58, 97, 107).

At the same time, industrial psychology had an astonishingly rapid growth in Soviet Russia. It did not have the advantage of war time development as in other countries. In 1923 there were only three psychology laboratories (30), but by 1930 more than one hundred and by 1934 nearly two hundred, with more than one thousand scientific workers in the psychotechnic (55, 88) society. Hundreds of practicing psychotechnicians are now found in industry, school, and the army (106).

In the Soviet Union, psychology has been working in a transition period of rapidly changing social order. Under these conditions the growth of industrial psychology is accom-

* This paper represents a cooperative study based upon an extensive analysis of scientific literature from the Russian journals. We are indebted especially to Mr. S. Diamond. Recently Dr. McFarland visited the Soviet Union investigating some of these problems through the guidance of Professors Spielrein and Gellerstein. We have attempted to report the scientific findings, leaving socio-economic interpretations to other sources.

panied by changes in basic theory and problems. In the following pages special attention will be given to the aspects of industrial psychology where these changes appear most clearly. It is in these aspects that Soviet industrial psychology is most distinctive.

EARLY VIEWPOINTS OF INDUSTRIAL PSYCHOLOGY

Against this shifting background a marked transformation in the scope and problems of Soviet Industrial psychology took place (66, 86, 87). The early approach to its problems was definitely individualistic. At the first conference for scientific organization of work in December, 1921, attention centered on the dispute between the Taylorists and the anti-Taylorists. The Taylorists aimed at the rationalization of individual jobs and the "rational exploitation of the human machine." Their leader was A. K. Gastev, head of the Central Institute of Work. Mechanized man seemed to be the great cultural promise of socialist society. Taylor was co-prophet with Marx of the new order (15, 16, 17, 18, 19, 20).

The anti-Taylorist group emphasized the need of protecting the individual against too sharp intensification of work. They were led by the physiologists Bekhterev (3, 4, 5) and Ermansky. "In a socialist state," said Bekhterev, "the rationalization and scientific organization of work must be based upon the fundamental principle that the maximum of productive work can only be procured by fully protecting the health of workers and by guaranteeing the complete development of their personalities." Rationalization was conceived by this group as being confined under socialism to mechanization of industry. Physiological and psychological practice and research was to be directed toward conserving the energy of the worker.

A pronounced individualistic approach to the problems of vocational psychology appears in the early writings on this subject. Spielrein in 1923 remarked that the "psychotechnician, when giving advice on aptitude for any group of occupations, will do well to free himself almost entirely from thinking about the *productive* connections of the various specialities

and will interest himself exclusively in their *psychological* character. . . . In a psychological examination we first study the man as such, not as a member of society'' (77, 78, 79). He found fault with classifications which were based on social factors. Kornilov's schema of isolated reaction-types was considered more valuable. It was found experimentally that some individuals when making a given arm movement tend to react more quickly or more slowly, more strongly or more weakly, than others. Kornilov proposed that this fact should be given a primary place in the determination of vocational abilities, since occupations might be similarly classified according to the type of reaction. Spielrein advanced a classification using three coordinates—the reaction-type (according to Kornilov), the attention-type (diffused or concentrated, constant or intermittent, auditory or visual), and the habituation-type (degree of automatization).

These viewpoints were prevalent in the early period of Soviet industrial psychology. The physiological aspects of the work-process seemed most important. Biological factors were stressed at the expense of social factors. Soviet psychologists have since regarded this emphasis to be characteristic of ''bourgeois psychology.'' The social factors were neglected because the distinctive social features of Soviet society, under a planned economic régime, had not yet appeared in industrial life.

It would be premature to describe in any conclusive form the new viewpoint in Soviet industrial psychology. An initial theoretical or abstract position had to be assumed before any practical work was begun. Many changes followed in the light of new experience. The present viewpoint and status of industrial psychology in the Soviet Union is a consummation of practical experience and can be understood most readily by reference to that experience (83).

THE CENTRAL INSTITUTE OF WORK AND THE DEVELOPMENT OF A NEW VIEWPOINT IN INDUSTRIAL PSYCHOLOGY

The first major institution to begin activity in the field of industrial psychology was the Central Institute of Work.

The CIW had a paper existence as early as 1920. Its first months, like those of other early laboratories, were filled with strenuous efforts to obtain suitable headquarters and to furnish bare rooms with necessary equipment. In those days even pencils and paper were scarce. Obtaining tables and chairs was a major difficulty. The acquisition of every simple scientific instrument was hailed as a triumph for the laboratory (15, 91, 96).

There is a misconception that this Institute served as a controlling body over Soviet industrial psychology. It has had great influence. But it cannot be said to have greater authority than other laboratories connected more or less directly with various government departments. Indeed, the methods of the CIW have had to undergo considerable change under the pressure of constant hostile criticism.

A characteristic schematism runs through every phase of the Institute's work. Its research plans were formed on a "narrow-base" policy. According to Gastev, all forms of manual operation might be grouped either under blow-work or pressure-work. A typical working process was selected, as representative of each class, for exhaustive study. These were metal-filling and chisel-hammering. The proper understanding of these two basic processes of work was regarded as an ample basis for attempting to make marked increases in efficiency of any sort of manual job. Every individual in a socialist state was to be the master of these elements of "work-culture."

A number of laboratories studied these two processes exhaustively from different points of view. They considered such problems as the proper weight of a hammer, the proper length and speed of the blow, and the correct height at which an object must be placed in filing. The basic method employed was motion study by means of luminous-point photography or the cyclographic method. A pedagogic laboratory attempted to discover the best means of teaching the correct methods of work. However fascinating the Institute's charted hammer-blows might have been, they drove no nails. Critics began to

murmur that the CIW was out of contact with the practical problems of industry (13, 105). They maintained that before the completion of these investigations through which it was hoped to reform human working-methods, Russian industry would be so changed by mechanization that the results would be inapplicable. In modern industry men must learn to direct machines rather than their own strength. Gastev reported that the study of these "typical" processes was necessary in order to establish a methodology of teaching workers. In 1924, "Organization of Work," the Institute's magazine, in its first issue after a lapse in publication of about two years, declared: "Now, after patient laboratory work . . . *we can say that we have the method*" (16, 17, 18). The first of the Institute's courses for instructors had been established in 1923 for locksmithing. Courses in assembly-work and lathe-work were added early in 1924.

Instruction in the courses was founded on the same principles as the research program. Separate elements of each task were assiduously rehearsed and then combined into the finished performance. The classes were drill periods. Pupils stood before their work-benches in standard positions and in places marked for the feet. There was a generous use of auxiliary training devices (such as motion study films) in correctly guiding hammering-blows and filing-strokes.

Gastev described the method as follows: "We begin with the simplest, the most elementary movements, and proceed to the *mechanization of man himself*. This mechanization we understand thus: the less perfect a movement is, the greater are the elements of inhibition in it, and the less its automatization. Complete mastery of a given movement implies *maximum automatization*. . . . The principle of mechanization of biological automatization must go very far, all the way to man's so-called mental activity. . . . *We recognize no difference* between so-called physical work and so-called mental work."

Interest in the new scientific methodology was widespread. The courses were taken by an extremely mixed group of pupils ranging from qualified engineers, physicians, pedagogues to

illiterate laborers. Instructors so trained spread the methods of the Institute throughout the Union. They gave courses in factories to new workers and to old workers desirous of improving skill. In many cities branches of the CIW were established. Instructors were provided to give courses similar to those of the parent institution. In 1928 there were such courses for sixteen occupations. They included courses in the metal industry for locksmithing, blacksmithing, casting, assembly-work, boiler-making, lathe-work, drilling, milling; in the textile industry for spinning and weaving; in the building industry for stone-masonry, iron-concrete work, plastering; and in woodwork for joinery and general carpentry.

The chief virtue claimed for the Institute's work was speed. Workers were trained for jobs in one-half to one-third of the time formerly required. This was not achieved merely by organization of the training process and the use of auxiliary devices. It was due principally to a reduction in content of training. Everything taught to the worker was kept within a minimum which had been arbitrarily decided as necessary for the job. The worker was frequently left with little understanding or reason for the various operations and procedures. Consequently, workers trained in the well-ordered instruction shops of the Institute were found to be somewhat at a loss when required to work under slightly different conditions in the factory.

Critics frequently objected to the fact that the course was so completely confined to the specific act in the work process (76, 112, 113). It gave the worker no understanding whatever of the relation of his work to productive machinery as a whole. It left the worker unmotivated in his job. To Gastev "work-culture" consisted mainly in a proper mastery of hammering and filing (102, 109, 111). To the ideologists of communism it meant a comprehension of the rôle of production machinery in society and of the part which one's own work plays in relation to the whole of the Soviet state. Every decision that granted the CIW permission to extend its methods into new fields was accompanied by a criticism of its narrow

viewpoint. It was always urged that the curriculum must include some instruction that would teach the worker the technical and social significance of his job.

While the need for skilled workers was crucial and other means of training were still rudimentary, the methods of the CIW continued to find broad application. As the system of trade-schools became well organized, the opponents of the Institute became more numerous. The CIW suffered a decisive defeat in 1931 when the program of polytechnical training for the general schools was under consideration. A commission was appointed at this time to investigate the advisability of using the Institute's methods. This commission included Zalkind, Vygotsky, Hellerstein, D. I., Petrov, Rosanov, and Spielrein, all outstanding psychologists. It confirmed the fact that the CIW had worked out methods which permitted the teaching of certain purely mechanical skills quickly but condemned the method without reservation for vocational training for school children.

During 1931, the CIW dispensed with the stationary training centers. The Institute continues to play an important part in the training of workers. It no longer produces "faultless automatons" for industry. Instead, it publishes instruction booklets for hundreds of specialized jobs in all the leading industries. These booklets are used by the workers for self-education. It also participates in the actual training of workers on the job.

The training courses of the CIW cover an interesting chapter in the history of Soviet industrial psychology. They were ambitiously conceived as an institution of major importance for the new socialist society which was to be founded on improved industrial technique. But they were outmoded in less than a decade by the progress of social change. The methods were tolerated only as long as the Soviet school system was incapable of meeting the great demand of industry for skilled workers.

In the autumn of 1932, it was estimated that 364,000 young workers would be graduated from the trade schools. Other

young people entering industry have the benefit of polytechnical training given in the general schools. Students are required to attend these schools for at least seven years. Some rural districts provide only four years of elementary education. In present-day Soviet society the training courses of the CIW appear no longer to have a place (13, 33, 36, 49, 50).

During 1933 public education has been changed so that it is now necessary for every child to take ten years instead of seven, even technical workers. Previously, after seven years of public school there were four possible ways to enter industry, *i.e.*, via (1) factory schools, (2) workers' faculty preparing for college, (3) technicum (further university study) or (4) continuation of the public school to the ninth year. Since 1933 after ten years of public school the students go into the factory school (six months of semi-skilled training) or into the Technicum for more advanced training. With this change, vocational selection has figured more prominently in the program so as to eliminate the unfit.

The original method of the Institute which sought to arrive at a hitherto unknown level of industrial efficiency through mechanization of the activity of the individual worker has been abandoned (100, 101). A part of the CIW work which has undergone steady expansion is its consultation service on factory organization, plant lay-out, and administration. This work was previously regarded as of secondary importance. Now it represents almost all of its program. Time studies of the job called "photography of the working day" are still important. They are used to set up norms for individual performance. Briefly, all those aspects of "social engineering" concerned with fitting the individual worker into the plant as a whole have gone forward uninterruptedly (25).

THE STUDY OF OCCUPATIONS AND THE TREND TOWARD INDUSTRIAL TRAINING

During the early period of industrial psychology in the Soviet Union, there were many who held the view that its chief contribution to industry would be in vocational selection.

The proper placement of workers in jobs for which each was best fitted was considered to be an important type of rationalization of work, that would at the same time benefit the individual. It was assumed that tests could be devised which would determine the type of work for which an individual was fitted by his "psychophysical constitution" (11, 12, 29, 64, 68). Up to about 1928, the problem of placement of workers was still attacked solely from this angle. A change of viewpoint occurred about this time. The term "vocational selection" began to appear less often. It was first replaced by the term "vocational guidance" and then by a new term —"vocational orientation."

These changes correspond with a shift in the nature of the psychologist's problem. At first there was an immediate need of selecting workers from an army of more than one million unemployed. They were markedly heterogeneous in occupational ability and training. Later the problem was chiefly that of directing the young adolescent workers into various branches of industry. This work was done in connection with the rapidly expanding system of trade-schools. More recently the problem has shifted directly to children in the general schools. The aim is to correctly orient children in the knowledge of the world of practical work so that they themselves may choose wisely their future education. This work is one in which psychological tests play a very subordinate rôle. The principal task is to give the children an intelligent understanding of the character of industry and the varied opportunities it offers (32).

Boltunov in Leningrad and Levitov in Moscow have carried out extensive testing programs with children medically and psychologically especially as to ability, desires, and interests. The children are taken to vocational museums in the large cities and questioned about the influences of their families and social and economic background. In Leningrad 41 per cent of the children wanted to be engineers and 13 per cent mechanics—due largely to the socially recognized need in industry for engineers in the daily press, etc., rather than to

basic interests or aptitudes. Recently an attempt has been made to give children ideas relative to other professions such as kitchen workers in factories and other trades than those related to engineering. The children upon entering public school are tested and given extensive vocational guidance.

A very intense discussion arose in connection with the intelligence testing program and vocational selection (54). The issue centered around the class principle of the Soviet State, *i.e.*, workers' children were placed first. How could this class principle and vocational selection be maintained? One view, more that of the Communist Party, was that intelligence tests should not be used since they were not in accord with proletarian ideas. The other view chiefly held by the psychotechnicians, was that intelligence was mainly a product of the social environment and that uniform tests should be worked out for concepts best known to the workers' children. Hence the Binet test was changed to fit in with the culture and by means of temporary or local standardization the problem of class was solved; they also held that there were no differences in the intelligence of man and wife or races. Thus the importance of the environment was recognized and the tests were to be used for studying achievement in terms of time or number of problems solved per unit of time. Sirkin tested 20,000 children in Kharkov and after dividing them into those of workers and employees he observed the changes in intelligence scores during a three-year period, 1924–1927. He recognized that the children from employees' homes tested higher but that the similarity in school environment decreased the differences and showed the possibility of development.

The "work method" of job analysis has been widely used as a basis for developing and constructing tests of vocational ability (6, 82). This method has been followed chiefly by a group of workers associated with Spielrein, who began his work at the Laboratory of Industrial Psychology of the Commissariat of Labor in 1922 (77). Two or more members of the laboratory staff would spend several weeks in learning

a particular job. They would keep careful daily protocols of their experience. Difficulties encountered, sources of fatigue, and other factors that appeared to influence the worker on the job were especially noted. At the end of this period the protocols would be discussed by the entire staff. An attempt would then be made to arrive at a psycho-physiological characterization of the job. The early studies of jobs were based on Lipmann's list of psycho-physiological characteristics, and more or less limited to various forms of sensory and perceptual discrimination. At first observations were concerned entirely with the actual working process. Later, the general physical and social conditions of the work began to be considered. This method of job analysis was not restricted to isolating characteristics that may be important in devising selection tests. It was employed often with a view to discovering suggestions for rationalization or reduction of fatigue.

The job of the motorman has been analyzed by the work-method (7, 81). "The vocation of motorman is characterized by motor reactions to irregularly appearing visual and auditory, and in part also tactual stimuli. The distinctiveness of this vocation is in the great number and mutual independence of the stimuli, whence arises the necessity to observe them and combine them, which makes automatization of the responses impossible (68), although some routine doubtless lightens the work. The vocational characterization is completed by habituation, working out of a common impulse, and resistance of the motor sphere (*i.e.*, no deautomatization or discoördination) to emotional discomfort, fatigue, and hunger." In accordance with this analysis, a series of tests was constructed. A multiple-choice reaction-test was used for measuring (1) speed; (2) accuracy; (3) docility (comparison of time and errors for trials 1 to 25 and 76 to 100, in a series of 150 trials); (4) resistance to emotion (comparison of errors in trials 26 to 50 with errors in trials 101 to 125), following the remark, "But you are supposed to work accurately, comrade;" and (5) confusion effect caused by an infrequent

stimulus (a green light appearing only 10 times in the series.) In addition to these tests a general intelligence examination was employed.

Baumgarten, in a review of the early Russian work, expresses surprise at the agreement of job analyses reached by the "work method" with those arrived at by other procedures. Spielrein points to some of the differences in job analyses revealed by the "work method." Judgment of visual distance was found to be fairly unimportant for motormen, since the tracks before them were relatively clear. Spielrein and Goldblatt (22) did not find speed of movement very important for telephone switchboard operators. Furthermore, they found that the chief source of fatigue was the necessity for constant auditory attention.

One of the most interesting and practical illustrations of the work-method is an analysis of the firemen's job (42). The important features of this study do not relate to the actual work of fire-fighting, which occupies only a few minutes of the average day, but to the routine conditions of the fireman's life. The necessity of always being ready for action, while generally having nothing to do, was found to be the principal source of fatigue. Inactivity is the worst hazard to the fireman's health. When this study was conducted firemen were required to be ready for duty 24 hours a day. A final recommendation was made for establishing length of shifts to other jobs.

Considerable effort has been devoted to devising tests of ability in the driving occupations (92), *viz.*, airplane (53) pilot, locomotive engineer, trolley motorman (81), and automobile chauffeur (40, 67). The lead already set in this field by other countries is being followed. The safety of many persons and the protection of much valuable equipment are seen as practical ends to be attained by carefully selecting workers for these jobs.

The first railroad laboratories were established in 1924 (51). A central psychotechnical laboratory for the railroads was opened in Moscow in 1925, with Kolodnaya (35) as directress. The laboratories in Soviet Russia, in comparison with those

of other countries, are undoubtedly among those thoroughly equipped for such work. But most of this elaborate equipment is now destined for early consignment to the storeroom. There is marked skepticism as to the value of testing workers for a particular job (69).

A conference was held in April, 1933, on psychotechnics in automotive transportation. The purpose of the conference was to arrive at a general agreement on procedures. It revealed wide discrepancies in the methods used by various laboratories in the testing of chauffeurs. There was also considerable difference of opinion as to the methodology to be used in constructing tests. Work in this field has reached a considerable magnitude. It has had to keep pace with the rapid development of bus lines and truck transportation. More than 20,000 chauffeurs were tested in 1932 at the Moscow Institute of City and Local Transportation. Similar laboratories are functioning in all the principal cities.

One report described "a portable method of testing chauffeurs" (40, 67). The method had been developed empirically. About 45 different short tests were administered to about 60 drivers, of whom half were considered "good" and half "poor." On the basis of correlations it was concluded that intelligence, motor ability, and emotional stability were essential. The investigator stated that these characteristics could be judged by testimony and simple questioning, supplemented by a few simple tests. The actual coefficients of correlation were negligible. But the principal criticism in a discussion of this paper was directed against the empiricism. The failure to seek a theoretical approach to the problem, and to base the test on a preliminary study of the job, was considered by the critics as evidence of irresponsibility.

The intensive development of tractor-farming gave rise to a new practical problem for vocational psychology (44). The Five-Year Plan required the training of more than 1½ million tractor drivers. Above all a tractor driver must be economical and conserve fuel and his machine. The driving itself is not difficult, since the speed is only about 4½ kilometers an hour and single furrows on large farms are five miles long. Only

normal vision is needed. But the tractor driver must pay constant attention to the various parts of his machine and see that they are operating correctly. For this part of the job good auditory perception is a prerequisite. A special "auditory board" was devised for this purpose (45). It consists of a wooden box whose face is 105 cms. square, and is divided into 100 squares. Behind this face are located five buzzers, one in each corner and at the center, which give a loud rumbling sound. In addition there are 25 buzzers placed behind separate squares. The task in this test is to point to the position of the buzzer whose noise is added to the sound of the five basic buzzers. Preliminary test results on 200 tractorists give a normal distribution. The average error was about 4 squares, with a maximum of 8 squares. Those with previous experience in repairing motors obtained the best scores.

It is also desirable that the tractor driver should avoid jerky manipulations since these often result in breakage. Steadiness and regularity of movement was tested with a "kinoergograph" (46). This involves a vertical lever that is pulled in one direction by a weight hanging over a pulley. The task is to move the lever smoothly backward and forward. A series of electrical contacts made at the base of the lever permits the measurement of steadiness and regularity in speed of the separate phases of the movement.

Job analysis is now conceived as having its principal task in the discovery of ways of improving training methods. There has not been a great deal of work done in this direction. A few attempts have been made to train workers in special skills of the sort which previously were considered basic "psychological traits" and for which selection tests were used. An endeavor has been made to train flax-spinners in tactual acuity by using an apparatus somewhat analogous to a spinning-mule.

Suggestions were presented for the training of blast-furnace workers on the basis of a job analysis. Two important reasons for the lack of success in attempts to train workers for the responsible positions in this work, without reliance on long

apprenticeships, were first, the fact that the most essential features of the process are not readily observable, and second, that the learner can not be permitted to make occasional errors. These are circumstances which may be overcome by pedagogic devices. Systematic training was recommended in color discrimination, in order to discern slight symptomatic changes in the appearance of the metal, and in judging the carbon content of different samples of ore. Both of these forms of discrimination are made by experienced workers with considerable accuracy.

It is along these lines that Soviet psychotechnicians seem determined to develop their science. The vocational selection procedures will be limited to a few special types of work that make exceptional demands on the physical constitution and require special sensory acuity. The chief task of the psychotechnician is no longer the proper distribution of the available labor forces but industrial training. The general plan is now to increase the technical skill of the entire population. It is a program which is founded on a dynamic rather than a static conception of human nature and occupational ability.

WOMEN IN INDUSTRY

As long as Soviet psychologists seemed convinced that the application of vocational selection tests might profitably be extended, they were also inclined to regard women as better suited for some types of work than for others. Experience in Soviet industry has given a very different answer. Women today constitute at least one-third of the industrial workers. There is evidence that they get along quite successfully in jobs which were hitherto closed to them. In the absence of carefully controlled studies it is difficult to make comparisons. It is undoubtedly true that those women who are working at jobs formerly reserved for men are still a rather selected group, whose qualifications for the particular job probably rank high in comparison with most women. One conclusion appears certain. The unfitness of women for the heavy industries and such work as mining and mechanical trades is not nearly as great as an *a priori* estimate would suggest. For example, the

women are doing a major part of the manual labor in building the new subway in Moscow (47).

Between 1929 and 1932 the number of women engaged in industry doubled. In certain industries and occupations there have been great increases in the proportion of women employed, *viz.*, coal-mining, metallurgy, machine-making, electrical work, automobile and tractor driving, skilled agricultural work, and the higher technical personnel generally.

The success of women on "men's jobs" in Soviet industry is in large part due to the special protection which they are given. A woman who has a nursing infant is allowed two separate half-hour periods daily, without reduction in pay, in order to care for the child. The morning period is usually added to the lunch hour, so as to permit a trip home. The afternoon period is taken at the end of the day. These periods may, however, be taken at other times of the day when it seems more desirable to the woman. All women are allowed several days of absence each month. In the event of confinement, a vacation of 16 weeks is provided for manual workers, and 12 weeks for "mental" workers. Every effort is made to arrange the job conditions so that those disabilities which are unrelated to the actual work process shall not limit the range of opportunities open to women workers (57).

WAGES AND ADVANCEMENT

Equalitarianism in wages has been recognized as a dangerous movement. "From each according to his ability, to each according to his needs" is regarded as an ideal which is Utopian at the present stage. Tough-minded Communist leaders are not inclined to waste their efforts in trying to establish Utopias. The transition to Communism is to be made through Socialism, a social system in which class differences have been eradicated, and each individual is paid according to his productive service. Even socialism still remains around the corner as an objective to be attained by the completion of the second Five-Year Plan. At present wage-scales are frankly adjusted in order to provide an incentive for increasing production (1, 37, 39).

It is an established principle that the more productive worker must receive higher pay. The piece-rate wage system has been widely introduced for all jobs where it is at all possible to set a quantitative norm. The accurate determination of piece rate wages is the task of the psychotechnician and is based on time studies. Hourly rates are paid where production can not be so directly measured. This wage system is limited to higher occupations and other jobs where unusual skill and accuracy are required. It is claimed that the piece-rate wage is not accompanied by the same detrimental effects as under capitalism. Under a capitalist régime, the piece-rate wage scale is seen as a means by which all workers are forced to exert greater effort and only the best workers receive adequate pay. Additional profits are obtained by downward revision of the wage scale whenever production increases and workers make more than "is necessary for them." In the Soviet Union, increased productivity is accompanied by an upward revision of the wage scale. Wages in the Soviet Union have steadily increased (52).

Social insurance (pensions and unemployment insurance), reduced rentals for workers with low wages, and free vacations, are factors which serve to eliminate the inequalities which exist between wages. The average worker receives about 20 per cent of his pay in such "indirect wages." This percentage increases as the direct wage decreases. Job security is in itself regarded as a powerful incentive. It removes the element of uncertainty and fear of discharge that might reduce the efficiency of the workers.

The problem of advancement on the job has a dual significance. It serves as a factor in motivation, and as a means of developing skilled workers and technicians. Only workers who do the best work are selected for advancement.

In the usual method of advancement the worker is first selected to take a course which will qualify him for some higher position. Such courses are given at all large factories. More specialized training is available in regular schools. Workers selected to attend these schools receive furloughs with pay and course scholarships. Workers' Faculties prepare

many thousands of workers who have had very incomplete education for the higher schools and even the universities. The selection of those who will be given such opportunity is to some extent in the hands of the workers themselves. They participate in deciding which of their fellows are most deserving and promising. In the desire to have their factory make a good showing and to obtain the services of a good technician when the period of training is over, they make a very sincere effort to select the best worker.

There have been occasional attempts in this method of advancement to develop testing methods for the selection of the most capable workers. But in general the test method has not been widely employed. However, it requires a considerable amount of organization in the working groups in order to successfully obtain judgments on the workers' actual performance. Where such organization is lacking, psychological test methods undoubtedly have their place. The psychotechnical station of the Kiev Evening Workers' Technicum in 1929 had a plan for examining about 3,000 workers and 1,000 poor peasants and laborers in order to select those best suited for industrial training.

An interesting study was made on about 100 railroad "employees" (a term used in contradistinction to "workers," and applied generally to those who have administrative or white-collar jobs) who were sent from all parts of the Soviet Union to attend courses in preparation for advancement, at a technicum in Leningrad. The facts present a broad characterization of one of the most important groups of workers who have to a considerable extent determined the success of the Communist program. According to age, 22.1 per cent were between 25 and 30, 72.1 per cent between 31 and 40, and the remaining 5.8 per cent were all 41 years old. Their average school education had been about 3.5 to 4 years. At the time when they were selected for the courses, 92.2 per cent were classed as employees; 35.1 per cent had started as employees. Forty-three and seven-tenths per cent had begun work on the railroad before the age of 16 and 39.6 per cent between the ages 16 and 21. Due to the demand for railroad personnel during the

World War, 80 per cent had not served in the army, and some of the others had served there only as railroad workers. More than 90 per cent were members of the Communist Party. The average period of party membership was 7.5 years for the group. An intelligence test showed them to be somewhat superior to entrants in ordinary technicums and trade schools. The results of a test of general knowledge correlated 0.44 with intelligence scores.

ATTEMPTS TO ELIMINATE FATIGUE IN WORK

The study of fatigue is one of the problems which has received most sustained attention (108, 110). Fatigue studies were among the earliest published reports of psychological applications in industry. Individual variability in fatigue puzzled investigators in the early studies and prompted a continuous search for new methods of measurement. The report of the commission studying the conditions under which the medical personnel were working in Leningrad appeared in 1922 in the short-lived periodical, (8, 103, 104) "Problems of the Study of Work." It was found that some doctors who worked rather swiftly in the morning, examined a smaller number of patients later in the day. Those who gave very thorough and painstaking examinations when free from fatigue gave more cursory and quicker examinations when tired.

Early studies of the fatigue of workers were made in Moscow factories (9, 10). Thirty workers in a tailoring plant were examined five times on Monday and the same number of times on Friday of each week. Over a period of seven months, at each examination records were obtained on reaction-time, on attention tests, blood-pressure, pulse, and on an ergograph. The best records on reaction time, attention tests, and the ergograph were made in the morning at the 11 o'clock testing. Throughout this prolonged study most individuals maintained consistent records and there was no evidence of the accumulation of fatigue. In several cases with illness or physical defect, the results became progressively worse during the extended period. It was suggested that tests of this sort could

be used to provide the necessary psycho-physical correction to the Taylor method and protection of the individual against over-intensification of his work. The Obukhov Institute for the Study of Occupational Diseases considered the method of fatigue investigation satisfactory if at least twelve persons were examined, with a combination of psychological and physiological techniques, before and after work for six days. In the laboratory at the Institute for Protection of Labor, fatigue studies generally included at least twenty subjects and examinations before and after work lasted for a period of at least six weeks.

With careful control and observation in order to maintain the production schedule, there has also been a sincere desire to improve the position of the worker as much as possible. It has been found desirable to permit frequent rest periods. The introduction of two ten-minute rest periods in the "Metallamp" factory (8) reduced working time by 4.2 per cent, and the accident rate by more than 10 per cent, and increased hourly output almost 8 per cent.

Rest pauses are introduced in all types of strenuous physical work. The physiologist and psychologist are often called upon to determine their length and distribution. Fatigue studies have been conducted on women sewing with a conveyor system. Records were obtained on a Bourdon cancellation test, a hand-steadiness test, and metabolism. The cancellation test showed the best differentiation between the two regimes studied. There was much less fatigue with a five-minute rest every hour than with a ten-minute rest every two hours. Proper rest intervals are also being considered for typists and stenographers.

Two investigators (56), working as stevedores, at the Baku oil-plant for several weeks, recommended that 15 minutes' rest should be allowed during each hour of work and that one continuous work period should never last more than one hour. This recommendation was put into effect immediately by the plant administration. There had been much concern over the high rate of accident and illness among the stevedores. It was

also suggested that the men should be shifted from one type of work to another several times daily, at least once every two hours and not more than once an hour. Eleven different types of work were distinguished according to the materials handled. The men were to work in pairs. Those working together were to be of similar physique. Such a grouping of workers was regarded as a factor which reduces accidents and increases the working tempo.

Physical exercise has been successfully introduced before starting work and during rest periods. Productivity was thus increased 3.7 per cent in a Metallurgical Plant (34), 5 per cent in a shoe factory, 7 per cent in a printing shop, and 11 per cent in a coal mine.

There has been considerable dissatisfaction with the methods used in the measurement of industrial fatigue (75). The physiological methods frequently fail to reveal definite results. Attempts have been made to utilize speed and quality of production as direct indicators of fatigue. Increased reliance is being placed on psychological tests. Attention-tests have been very widely used especially the Bourdon cancellation test and the Nechaev test (53, 54). The latter aims to measure attention by the ability to recall a dozen two-place numbers presented orally. No one test has received general recognition for its reliability. Generally the experimenter uses a series of four or five with the hope that at least one may differentiate clearly between the two experimental procedures or methods of work.

The most significant trend in this field has been the efforts to construct specific fatigue tests for the different types of work (24, 70, 73, 74). Since the same symptoms of fatigue could not be discerned in different kinds of work, special methods of investigation were considered for separate jobs. In the "respiratory stop method" (43) (the short pause which intervenes between an inspiration and the succeeding respiration) a decrease in the duration was found to be a delicate measure of fatigue in muscular work and of no significance in mental work.

Another investigator stated that fatigue should be measured not in isolated functions but in terms of decreases in production (72). The emotional tone associated with work may readily prevent the production curve from falling up to the point of extreme fatigue. In order to overcome this difficulty it was decided to measure "work tonus" on a task analogous to the actual job. The fatigue of library workers was investigated (71). A 16-page notebook was prepared. On each right-hand page was a group of library index-symbols and the left-hand page was blank. The instruction was to look at the right-hand page until satisfied that the symbols could be recalled. Then this page was turned and the symbols retained were written on another page. The investigation revealed that it was possible with this test to discover individuals in whom there was marked fatigue.

In order to measure the fatigue of women, whose work required from 13,000 to 15,000 stamping motions daily, tests were used for resistance to automatization, speed of exact movement, and steadiness of the working hand. Resistance to automatization was measured by responses in pressing an electric key with the right hand on the command "one" and another key with the left hand on the command "two." The commands were then given to the rhythm of a metronome beating 56 times a minute. Only 8 commands in a series of 100 were "two." Speed of accurate movement was measured by the time required to insert 25 spokes through 25 pairs of holes. Arm-steadiness was tested with a tremometer of new design (34). A metal ring with a wooden handle was placed over a vertical steel rod. The rod was 5 mm. in diameter. Three rings were used with diameters of 6.5, 7, and 8 mm. respectively. Contacts were recorded during a period of 30 seconds while the ring was held at a height such that the arm and forearm made a right angle. The authors consider that this tremometer gives results superior to the steadiness test in which a stylus is inserted in a hole. They find that the arm-position can be more easily standardized and that there is less practice effect. The occasion for this study was the shift

from an 8-hour day to a 7-hour day and an addition of a 15-minute rest 2 hours before the end of work period. Of nine subjects used, all but one showed almost total elimination of fatigue. The exception was a pathological case and revealed signs of increased fatigue.

The Second Five-Year Plan (25) calls for a gradual reduction of the standard work-day to 6 hours (with a correspondingly shorter day for adolescents, night-workers, underground workers, and outdoor workers in cold weather). Soviet industrial psychologists may indeed wonder whether direct fatigue at work will become a negligible problem before they can reach any general agreement on methods of measuring it.

The contributions of Soviet physiologists loom important in the fatigue studies. They have assisted in analyzing the metabolic cost of muscular labor such as forging and bricklaying in terms of the gas exchange in the blood and inspired air. Kahn, for example, whose "pure research" is in nerve respiration, has studied the O_2 consumption during different kinds of work like filing, sawing, or hammering. The research was planned to throw light on the effects of training and the various phases of working sessions relative to effective rest periods. Curves relating to the O_2 consumption in various activities have been calculated for the phases of (1) increasing O_2 consumption, (2) the "stable or steady" consumption, (3) local restoration (early rest phase), and (4) general restoration (late rest phase). The respiratory exchange in various kinds of construction and metallurgical work has been analyzed. They observed that energy expenditure was related to the degree of mechanization.

The physiologists have also studied fatigue or efficiency during the various working shifts in terms of circulatory, respiratory, and blood changes. They found that of the three shifts, day, evening, and night, the greatest fatigue occurred in the evening. Women showed the greatest loss during the day and the men in the evening and night. In the Urals the frequency of cramps in men working at high temperatures has been analyzed and attributed to the depressing effect of

heat on the brain centers, releasing and heightening reflex activity. This was especially noticeable in cases with endemic goiter where heightening of reflex occurs. The physiologists have carried out a wide variety of researches in industry ranging all the way from changes in chronaxy produced by work to job analysis with medical or efficiency implications.

A special field for research on fatigue is the army. The soldier must meet the maximum test of human endurance. The psychotechnical laboratories of the Red Army conduct studies on fatigue in running, marching, and trench-digging, with a view toward determining the most efficient procedures.

The school also presents special problems in the study of fatigue. The psychotechnical laboratory of the Kiev Evening Workers' Technicum (28), which began work in 1924, made a systematic study of hourly, daily, and weekly variations in fatigue. They gathered data in more than 10,000 individual testings over a period of several years. These results were used in planning the curriculum. The most difficult courses were to be given at the hour when the students are most alert. Similar investigations on a less extensive scale have been conducted in many schools and universities (80).

MOTIVATION OF WORKERS

The achievements of the Soviet Union have been in a large part due to sustained popular enthusiasm in the face of hardship. The ubiquity and effectiveness of propaganda directed by government agencies is one of the aspects of Soviet life most frequently commented upon by visitors. But the psychologist has not played a great rôle in planning and directing propaganda campaigns. The state power has been exercised by an organized political party, with a generation of experience in propaganda, whose major task has been to win the following of the broadest masses. These experienced political leaders, therefore, had little practical reason for calling academic psychologists into consultation in order to plan a propaganda campaign. The realistic character of Soviet propaganda placed on obvious limitations on the immediate participation of psychology.

Communist propaganda had to fit an already crystallized ideology. It had to be directed to destroying prejudices rather than to appealing to them. It aimed to publicize the program accurately in order to obtain the greatest popular support. Communist propaganda was not planned as an appeal to basic traits of human nature. It is regarded as a force which will change human nature.

In capitalist countries a great deal has been written about the impossibility of eliminating individual competition and the profit system with individual rewards. The Communists have taught the children in a highly emotional way that profit is a sin and to be rich is anti-social. Socialist competition on the other hand has been related to the various groups, *i.e.*, between factories as to the quantity of production, between hospitals as to the efficiency and effectiveness of their work, and between schools as to the quality of their art, sculptoring, or handicrafts. Thus the individual is taught to better his own work or participate in a group to surpass a quota set by the factory, trade union, or party leaders. In this way, they argue, there can be no exploitation of man by man. There is a great deal of propaganda in the press, on posters in the factories or parks relative to individual or group improvement whatever the subject. In factories and even in scientific institutes the workers' names may be posted on a bulletin board opposite a bird, deer, rabbit, tortoise, or snail relative to the speed with which they turn out their work. A great deal of prestige is attached to the "shock brigade" worker and rewards of extra pay and larger vacations. From a legal point of view, inefficiency is the greatest crime as well as neglect of duty, and both are punishable by legal sentences and in extreme cases death, as in causing a railroad accident. Thus innumerable schemes have been devised to overcome any natural indifference to work and to "get the workers going."

The propaganda problems of psychologists in the Soviet Union have been until very recently connected only with the advertising of their own wares. It has been up to the industrial psychologists to direct campaigns which would introduce their methods into industry.

The Central Institute of Work was one of the most enthusiastic and persistent propagandists of psychological and Taylorist methods (20). Gastev was a gifted writer as well as an ardent Taylorist. His pamphlet, "How to Work," was issued long before the laboratories of the Institute were equipped for research. It aimed to make readers conscious of their working methods. This short pamphlet was distributed in hundreds of thousands of copies. It told readers that they must keep the work-bench in order, they must never become flustered by mistakes, and they must think over the procedure carefully.

A popular form of the campaign for scientific organization of work was the time-saving campaign (94). Industrial psychologists were quite active in supporting it. Local time clubs were organized into a national time league. They sprang up everywhere. Its members were pledged to punctuality and to systematic ordering of the day. It was a great drive for personal efficiency. Everyone was encouraged to study his time-budget and to discover the minutes which were slipping away unused.

A number of interesting time-budget studies appeared in this time-drive. It was found that women were being overworked in comparison with men. More specific data are shown in the tables that follow.

Time-budget studies were also made on students. Special interest was attached to investigations on students who worked during the day and studied at night. The results of these studies suggest that direct comparisons of various groups in susceptibility to fatigue at work would necessarily have to take into consideration the distribution of time in the various other activities of the day.

An important part of the propaganda campaign for scientific organization of work consisted of newspaper articles reporting actual results obtained with various groups of workers. It is worth noting, in connection with what has been said above about the realistic character of Soviet propaganda, that these

TABLE I

Comparison of Men and Women Workers in Distribution of Average Time for Daily Activities

ACTIVITY	MEN		WOMEN	
	Hours	Minutes	Hours	Minutes
Work	8	32	8	9
Travel to and from work	–	50	–	35
Work at home	2	8	5	12
Dining	1	34	1	11
Sleeping	7	59	6	44
(Holiday sleep)	8	6	6	58
Visits—entertainment	–	57	1	7
Military training	–	1	–	0
Unaccounted or Inactive time	–	56	–	3

TABLE II

Comparison of Men and Women Workers in Percentage Distribution of Total Time and Daily Activities

	MEN %	WOMEN %
1. Work, self-care, self-education, voluntary community service	52.4	62.2
2. Rest, Dining, Entertainment	14.3	9.8
3. Sleep	33.3	28.0

articles were not of a popularized character, but were serious informative statements.

The restriction of psychologists in general from the active study of propaganda methods may be seen in the fact that Gastev, who was the publicist of his Institute rather than a member of its scientific staff, was often severely criticized for the use of "advertising methods." Under the direction of Gastev, the pages of two periodicals, "Organization of Work" and "Installation of Labor Power," took on an unusual, and at times, a bizarre style. Pages were spotted with phrases set off from the sentences in which they occurred by being placed in the middle of the column as captions. This created a slogan-like effectiveness which was accentuated in bold face letters. The terminology was unusual and included many

neologisms for effectiveness. A general mechanistic philosophy pervaded all these writings.

Gastev's schematism in research plans, in page-editing, and in the organization of the C.I.W. courses led directly to the free use of a variety of charts. These enliven the pages of C.I.W. publications. No true C.I.W. man would ever say in a paragraph what could be said with a graph. Fascinating illustrations aimed to put over the cultural value of knowing how to hammer. This aspect of C.I.W. technique was destined for more extensive development. In the work of the C.I.W. on plant organization the charts assumed great importance.

These charts have had an important place in the popular campaigns for mastery of technique, for fulfilling factory and shop plans and for meeting individual standards. At first the charts were used as an effective way of presenting results and later they became an active instrument of organization. It is now the recognized work of an industrial psychologist to devise charts and graphs that will show the workers most vividly what they must do and to what extent they are accomplishing results. Charts of plan and performance are incentives that must hang before every worker. They are not merely controls to be studied by the plant engineer in his office.

The charts are also used with the "socialist forms of labor" (26). These forms of motivation and their many modifications arose quite spontaneously from the workers themselves in answer to the problem of increasing efficiency. They have assumed enormous proportions. At the beginning of 1932, 65.3 per cent of employed women and 64 per cent of employed men were organized as shock workers. It is stated that these percentages have greatly increased in the last two years. These methods of stimulation have been regarded as decidedly more effective in increasing industrial efficiency than the attempts at human mechanization or vocational selection.

The shock-brigade consists of a group of workers pledged to exert every effort in order to complete the shop or factory plan. Under socialist competition, shops, factories, mine-shafts, gangs

of workers, compete with each other in fulfilling their plans or exceeding them. Under the *system of social tow,* a factory ahead in production sends a brigade of its best workers to another establishment of the same sort which has not been doing so well. This brigade aims to show how production and quality of work can be improved. Astonishingly good results have been achieved in this way. The *counter-plan* is a production-schedule drawn up by the workers themselves when they feel that the administration has underestimated their capacity.

The successful operation of such schemes as these depends on the presence of two conditions. The workers must feel that they are working for themselves and there must be a definite plan of production. The second of these conditions was not fulfilled before the Five-Year Plan. With the inauguration of the Plan "socialist competition" began to attain maximum results.

In spite of the genuine concern on the part of the Soviet government for the welfare of the workers, the intense and hectic activity of the reconstruction period has had certain repercussions on the health of workers, especially the biologically unfit. The methods which have been used to "keep the workers going" such as shock brigades, quotas, inter-factory competitions, and various propaganda techniques for speeding up production have carried many to the breaking point. Cases of "exhaustion" and neuraesthenia have increased while other types of nervous disorders related to economic or group insecurity and religious or sexual "guilt" have supposedly decreased. Workers with schizoid or "shut in" personalities are moulded into the group while those with manic tendencies are placed on shock brigades. The elaborate system of rest homes which are frequently well equipped with physio-therapy, and long vacations have dealt fairly successfully with the "exhaustion" cases (63).

Safety programs and campaigns to reduce accidents became an important responsibility of the industrial psychologists. In this work propaganda methods appeared very useful. A great deal of interest was centered about the problem of the

correct content for safety-posters (60). Until quite recently, Russian safety posters usually had a negative emotional content (61, 62). They depicted an accident or the consequences of an accident with considerable amount of blood splashing about the scene. This is quite contrary to the practice in other countries. In 1929 a leader in this field reported that 95 per cent of Russian safety-posters and only 54 per cent of American safety-posters were negative in emotional tone (59, 60, 61). In 16 per cent of the Russian placards blood was shown, and none were humorous. American posters never show blood and 13 per cent are humorous.

A number of experiments were conducted in order to determine the correct content for such posters (2). For immediate effectiveness, horrifying posters seemed superior. When workers looked through an album of such posters, longest time was spent on those with negative emotional content. The negatively toned posters were remembered 1.5 times better than the others by "employees," and 3.5 times better by workers. This approach to the problem was found to be too crude. Another investigator attempted to construct posters more specifically in order to cover the varying reactions of different groups of workers. The reactions of individuals to various posters were ascertained in an experiment. It was found that posters in order to be effective must be understood. They must be straightforward. Technical details must be presented accurately rather than strikingly. Legends that are to be read should be as short as possible. Blood and horror were quite ineffective because they did not frighten.

Studies have also been made to discover the reactions to posters of different age and vocational groups. Horrifying posters were especially attractive to the young workers. Older workers were indifferent to the emotional tone of the posters. Workers with special training in safety technique were far more interested in the non-horrifying posters (65).

Interesting observations concerning posters were reported at a conference in 1932 on the industries in the Ural (62). The new industries of the Ural were being built up largely with

labor-power drawn from the peasantry. The posters that were commonly used in factories were regarded as unsuitable for these peasants. A young peasant left alone for five minutes in a "fright-corner" decorated with typical safety posters would likely run away and never return to the factory. In addition, such posters are held to be decidedly counter-revolutionary. In the same year a paper entitled "The Safety Poster on a New Level" (60) proceeded with an analysis of foreign safety posters. Propaganda content of foreign safety posters aimed beyond the mere question of accident prevention. An American poster was described which told the workers that "all the earth's treasure cannot buy life and sound limbs." This is regarded principally as a lesson in the preservation of law and order. A German poster urged workers not to smoke, because factory-fires made unemployment. An Italian poster said that the three best reasons for avoiding accidents were mother, child, and fatherland. A Canadian poster, with a picture of the Prince of Wales, carried the facsimile of a newspaper clipping: "Prince snatches mechanic from pounding machine." Here the suggestion is made that every factory should have its prince.

Soviet posters were criticized because they lacked distinctive quality. They failed to draw on the arsenal of political and class motives. In a socialist society, the safety poster must be constructive and not be passively philanthropic. "Master the technique of your industry" should be the basic slogan for all such posters. The future safety posters in the Soviet Union should be constructed with a view to imparting technical knowledge. The source of motivation which the posters are to tap will be the politically founded desire of the worker to master technical knowledge.

THE TRAINING OF PSYCHOTECHNICIANS

One of the major problems which the industrial psychologist had to deal with from the beginning was the task of training a large number of psychotechnical workers. At no time have training courses been able to keep up with the

demand for psychotechnical workers (84, 85, 90). Even in 1933 only about one-third to one-half of the persons engaged in psychotechnical work were properly trained. A special course devoted to the training of psychotechnicians is conducted at the Herzen Institute in Leningrad (98, 99). It graduates from 20 to 30 students annually. Most of the psychotechnicians in the Soviet Union have been trained in short courses of only a few months' duration. Many of the students enter with a good background of pedagogical or medical training.

The psychotechnical division of the Herzen Pedagogical Institute announced in 1932 a six-semester course totalling 4,032 hours of class work and 3,528 hours of practice. Instruction is grouped in four cycles as follows:

1. Sociological (economics, historical, and dialectic materialism)—Leninism.
2. General preparation (physics, biology, physiology (93), psychology, pedagogy, mathematics).
3. Special preparation (rationalization, hygiene, work instruction, psycho-technical analysis, selection of workers, experimentation).
4. Miscellaneous (foreign languages, military discipline, physical culture).

The number of hours indicated for class work includes laboratory work. Practice refers to actual work in industry. This begins with the mastering of basic industrial practices, first in the Institute's shops and then at machines in factories. Later there is practice in the organization of labor and other aspects of psychotechnical work.

It has been proposed that special courses be established at some of the larger psychotechnical institutions in Moscow, Leningrad, and Kharkov, for those who lack the necessary educational background to profit from short courses. They would particularly aim to provide training for the laboratory assistants with only moderate general education but with considerable experience in psychotechnical work. A course lasting from one and one-half years to two years' duration was considered adequate in preparing these assistants for advance-

ment. This procedure is in line with the system of advancement prevailing in industry.

The generally low level of theoretical training has had its reflection in frequent laxity in experimentation and especially in careless mathematical treatment of results. A prevailing scorn of mathematical treatment existed. But there has been definite progress in this respect. The skepticism toward statistical demonstration has been regarded as a guarantee against careless interpretation of results.

Recently the question of professional ethics among psychotechnicians has been widely discussed. One question related to basic elements and amount of training before practising. The task and responsibility of psychotechnicians in industry was very great and hence like the doctor and the teacher should come up to legal qualifications. For example, they found one person in Moscow giving tests to children for money without the proper test blanks. Another question of professional ethics was related to expelling those who rated below the test requirements. A group of auto workers was tested and those who couldn't pass were fired. In 1932–33 a similar case occurred in the coal industry where the mining mechanics who tested lowest were expelled. Such practices have been abandoned and the problem approached from the point of view of how much ability does a young man need for improvement or for acquiring skills. Another interesting case occurred in Baku on the Persian frontier. The street car conductors were tested and the results showed the best ones were Russians, the next best Armenians, and the worst Turks. An examination of the data showed that race in itself was not the basic cause of the difference since the Turks were peasants for the most part from around Baku, while the Russians were city workers and also the tests were made in the Russian language which handicapped the other racial groups.

THE PSYCHOLOGIST IN THE SOVIET STATE

Industrial psychology in the Soviet Union has borrowed quite readily from abroad. In its early period it looked

to the West not merely for techniques but for instruction as to the very problem which it might attack. Soviet psychotechnics was then frankly imitative of Western methods. Maturity was measured by comparison with Western achievements. This was natural, in view of the general recognition of the necessity for introducing technical improvements from abroad in the reconstruction of industry. It was long before this attitude was abandoned. As late as 1928, an editorial note opening the first volume of the new journal, "Psychophysiology of Work and Psychotechnics" (110), declared that "one can scarcely oppose a capitalist technique to a communist technique." Although there was general recognition that the facts of psychotechnology would possibly have a different application in a socialist society than in a capitalist society, there was then no suspicion that the facts themselves would be different.

But a science is defined by its problems as well as its technique and Soviet psychologists have seen their problems transformed. The social changes incidental to the First Five-Year Plan thoroughly changed the structure of Soviet industry. There was scarcely a problem in the relationship between men and their machines that was left unaltered. This situation gave rise to a great deal of theoretical discussion. Soviet psychologists examined their theoretical position far more carefully than they ever had before. Major consideration was given to the difficulties met in practical experience in the efforts to assist in the general social reconstruction. They were aware that the initial program which was based altogether on the experience of applied psychology under capitalism had undergone many changes. They felt that more radical changes were needed if they were to give maximum service under the changed conditions prevailing in the Soviet Union. They traced the inadequacies in their work to a mistaken reliance on a theory and a methodology developed under a profit-economy. This viewpoint was crystallized in the discussions of the First All-Union Conference for Psychotechnics and Psycho-physiology of Work that met in Leningrad toward the end of May, 1931 (41).

Three months later the Seventh International Conference for Psychotechnics met at Moscow. Foreign visitors at this Conference were astonished by the repeated statements of Soviet speakers that psychotechnics in a socialist state must have other problems and other methods than in a capitalist state (95). These statements were interpreted as an index of servile submission to a political dogma which was irrelevant to science.

In many ways the problems of greatest psychological concern since the Revolution have been quite similar in Russia and America. The chief issues of behaviorism, stimulated there by the work of Pavlov and Bekhterev and the reflexology school and here by the outspokenness of Watson, threw many of the psychology meetings and congresses into bitter controversy. Could psychology stand alone free from physiology and biology on the one hand or sociology, philosophy, and psychical concepts on the other? Is the mind a machine or an organism? Can qualities and subjective data be admitted into scientific psychology? And more particularly, how do these psychological concepts fit in with Marxian materialism? These controversies were followed by equally intense ones over the relative importance of heredity and environment, the nature of intelligence and its relative dependence on the cultural setting, the importance of sex, racial, and individual differences. In Russia these discussions were complicated by the official attitude of the Communist Party and Soviet ideology of Marx and Lenin. Their rationalization or escape from these problems have been more naive than in America, but not fundamentally different in kind.

The Soviet psychologist sees himself as set before new problems. These are to be successfully attacked only with a theory which lays chief stress on the power of social influences to mold personalities in order to create new possibilities of human performance. Marbe's tenet that accidents are due to an inherent predisposition in the individual is attacked as a bourgeois concept. They shift it to multiplicity of other factors—fatigue, nervousness, alcohol, overwork, worries, etc.—mainly due to local or environmental factors. Their program

is different from that of the "bourgeois psychologist." The viewpoint of the bourgeois psychologist must conform to the interest of the ruling capitalist class in stability rather than change. The concept of personality is therefore static rather than dynamic and places great stress on original biological endowment.

The Soviet psychologist believes that the strategy of exploiting workers will always prohibit any approach toward intensive technical education of the masses under capitalism. The planlessness of a society which depends upon private enterprise prevents any serious approach to the problem of vocational guidance. Under the guise of "social motivation" capitalist economy will never intentionally arrive at anything beyond some new form of "opiate for the masses." The necessary premise for all work in this field is the peaceful collaboration of competing classes. One who pretends to believe that any sort of human or economic problem can be handled without reference to the existing political scheme, is merely exhibiting thereby a bourgeois *laissez faire* prejudice in favor of the private ownership and control of property.

To the objection that "psychological facts are facts and their real status is not affected by their discovery in Moscow or New York," he replies that the view is not supported by actual experience. The dependence of the industrial system on social factors has been demonstrated. The method of attack, the problem, and the facts will differ in socialist Moscow and in capitalist New York (31, 89).

The "bourgeois psychologist" is not regarded as the wilful partisan of a malicious capitalist. But it is assumed that his acts, like those of other men, are determined more by the economic form of the society in which he lives than by any other factor.

Many problems of great interest to the psychologist are to be found in the new social order, especially as related to motivation in industry. The basic issue relates to the margin of adaptability of human nature with the environmental setting. The classical economists like Adam Smith and Ricardo

and Mill constructed concepts of an "economic man" as related to social beliefs and concepts of their time, assuming that many of those characteristics were rooted in human nature. More recently, cultural anthropology and psychology have shown the relativity of these so-called native traits with various cultural settings. The Soviets do not believe that human nature exists *in vacuo* but that the social milieu molds the personality. One can easily understand the popularity of Pavlov's concepts with the Communist Party. Thus the basic educational theory is to mould the child from birth according to the new ideology. Theories of *laissez faire* in education are scorned the same as in economics. There is great certainty in the minds of the Communist Party leaders of the Soviet that the profit-motive can be redirected, that group competition can be substituted for individual initiative and competition, that feelings of class, racial, and individual differences and superiority can be suppressed, that anthropomorphic religious concepts can give way to those of contemporary social betterment and certainty. These beliefs are basic in the Soviet theory that their great continent can be expanded and developed under Socialism as successfully as America has been developed under capitalism. In fact, these theories have tremendous implications in industry. It is yet too early to judge their success, but certainly a vast laboratory for research has been opened up to the industrial psychologist.

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A FURTHER STUDY OF SPEED OF TAPPING IN EARLY CHILDHOOD

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THE subjects of this study were 240 children between the ages of 2½ and 5½ years enrolled in the nursery school and experimental kindergarten of the University of Minnesota Institute of Child Welfare during a period of three years, and an additional group of 32 kindergarten children who took part in an earlier experiment. Midway between birthdays each child is given a fairly large number of tests of intellectual and motor functions and by means of controlled observations, ratings, and similar devices, data are also collected regarding his emotional and social behavior, his play interests, choice of companions, etc. All tests are given within a period of one month on either side of the date occurring midway between birthdays; *e.g.*, the 3½ year age-group includes only children who, at the time of testing, were between the ages of 3 years, 5 months, and 3 years, 7 months. Because of the very rapid growth in all aspects of ability and conduct which takes place during the early years the current practice of including six months or even a full year of age-range within a single group for purposes of statistical treatment is unfortunate. The effect of the age-variance is to give a spurious appearance of reliability to measures that have little stability apart from that given by the factor of age, and to bring about an apparent correlation between measures that have little in common with each other beyond the fact that both are changing with age. In addition, the increased dispersions of scores within a group lowers the reliability of the means obtained for successive age levels as indices of growth. It is to be regretted that we were not able to control the age factor even more rigidly than we have done,[1] but at least the age variance

[1] As a matter of fact, the great majority of the children were tested within a very few days of the six-months' birthday. The month's leeway

is considerably smaller than reported in most studies of this kind.

Two measures of speed of tapping were used; *viz.*, tapping with stylus on a metal plate in which the number of taps is registered on an electric counter, and finger tapping on a key-drive adding machine (the Comptometer). The procedure used for these tests was the same as that reported in an earlier study.[2] The time limit for each test was 10 seconds. The stylus tapping was done first with the right hand, then with the left and repeated after a short rest period, thus making two trials with each hand. The comptometer tapping was done on the day following the tapping with stylus. The following order was maintained in all cases in using the comptometer: unimanual tapping, first with the right index finger, then with the left index finger, right middle finger, left middle finger, right little finger, left little finger. After a rest period, bimanual tapping, taking the fingers in the same order was tried. Brief rest periods of about half a minute each were allowed between all trials. Both with the stylus tapping and the comptometer, a brief fore exercise was given in order to acquaint the child with the procedure and apparatus.

Table 1 summarizes the findings for the tapping with stylus by ages and sexes separately.

Between the ages of 2½ and 4½ the improvement with age is very rapid, but that made between the ages of 4½ and 5½ is much smaller. In the earlier study by Goodenough and Tinker, the average age of the children classified as 5½ was 5–6 weeks greater than that of the cases included here and

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was employed only in those cases for whom the official date coincided with a school vacation, a temporary absence due to illness, or similar conditions when too rigid an enforcement of the age requirement would have meant the interruption of the series of annual measurements. The standard deviations of age for the various groups rarely exceed 10 days. Although our procedure has not completely eliminated the effect of concomitant variation due to age, it at least has tended to minimize it.

[2] Goodenough, F. L., and Tinker, M. A. A comparative study of several methods of measuring speed of tapping in children and adults. *J. Genet. Psychol.*, 1930, 38, 146–160.

TABLE 1
Summary of results on tapping with stylus

	2½		3½		4½		5½		5½*
	B	G	B	G	B	G	B	G	Both sexes
Mean no. taps									
Right hand									
Trial 1	26.8	21.4	33.3	32.7	37.0	40.9	40.3	39.3	42.1
Trial 2	28.5	25.8	29.1	32.2	38.6	37.6	40.7	39.1	40.9
Left hand									
Trail 1	25.3	21.4	31.8	29.8	35.4	35.4	37.5	36.5	39.8
Trial 2	25.7	22.2	29.5	28.4	35.5	35.1	35.7	35.9	37.8
Standard deviations									
Right hand									
Trial 1	9.5	6.2	8.8	6.0	9.8	9.2	6.9	9.7	5.6
Trial 2	8.9	5.8	5.7	6.0	9.5	9.6	6.4	6.8	6.8
Left hand									
Trial 1	8.8	5.9	6.7	7.4	7.3	5.1	8.5	8.7	7.9
Trial 2	8.6	6.5	7.4	7.3	8.1	5.7	7.4	8.4	6.6
Reliability									
Single trial									
Right hand	.77	.73	.72	.77	.73	.78	.68	.76	.77
Left hand	.79	.24	.82	.60	.67	.85	.75	.66	.52
Two trials									
S-B formula									
Right hand	.87	.84	.84	.87	.84	.88	.84	.86	.87
Left hand	.88	.39	.90	.75	.80	.92	.85	.81	.68
No. cases	17	9	31	27	36	24	49	47	32

* Previous study.

the mean scores were slightly higher. The averages for the two trials in the former study were 41.5 and 38.9 for the right and left hands as compared with 39.9 and 36.4 for sexes combined in the present study. Even if the earlier standards are substituted for those obtained in this study, a decided slowing off in the growth of this type of motor ability appears to take place between the ages of four and five years.

Working under the same conditions, the mean number of taps made by college sophomores was found[3] to be 78.3 with the right hand and 67.7 with the left. If we combine the results for the two sexes in the present study, and express the resulting score for each age as a percentage of the adult level we obtain the values shown in Table 2.

TABLE 2

Percentage of Adult Speed Attained by Children at Different Age-Levels (Stylus Tapping)

	2½	3½	4½	5½	5½*
Right hand	33.6	40.6	49.0	51.0	53.0
Left hand	35.7	44.5	52.3	53.8	57.2

* Previous study.

The average gain per year made during the period from 2½ to 4½ is at least twice as great as that made between the age of 4½ and 5½, even if the scores made in the earlier study are used as standards.

In agreement with practically all previous investigations, this study shows a distinct difference in the tapping speed of the two hands at all ages. If the results for the two trials and for both sexes are combined, a small and unreliable tendency for the difference in the speed of the two hands to increase with age is seen. The hypothesis is given some further support by the facts presented in Table 2 which show that for each of the five groups considered, the ratio of child speed to adult speed is slightly greater for the left hand than for the right. This indicates that during the period of later

[3] *Op. cit.*

childhood and adolescence the right hand makes a slightly greater gain in speed than does the left, which is presumably due to its greater use.

Tables 3–4 show the means and standard deviations of the scores earned on the comptometer test. Table 5 shows the correlations between the unimanual and the bimanual scores for the same fingers. It was found in the previous study that these correlations tended to be slightly lower than the reliability coefficients obtained by retesting with the same method but the differences were not great.

TABLE 3

Means and Standard Deviations of Unimanual Tapping With Comptometer by Age and Sex

	3½		4½		5½		5½*
	Boys	Girls	Boys	Girls	Boys	Girls	Both sexes
Means							
Right Index	18.9	19.3	28.7	27.3	32.0	33.7	28.1
Right Middle	18.8	17.1	25.7	27.0	31.6	32.5	27.3
Right Little	12.1	13.3	20.0	21.4	25.0	28.1	23.5
Left Index	14.9	14.8	23.2	20.5	23.7	25.5	23.3
Left Middle	14.1	12.1	19.5	19.7	22.1	23.6	22.3
Left Little	7.7	5.8	12.5	11.9	15.5	17.2	15.0
S. D's							
Right Index	4.8	8.2	7.9	7.2	7.2	7.0	8.0
Right Middle	7.8	7.7	6.9	7.4	7.0	6.5	7.6
Right Little	6.4	5.1	6.4	6.4	8.3	5.6	6.8
Left Index	4.5	5.3	5.3	6.4	5.7	5.7	5.9
Left Middle	4.3	3.9	5.0	7.5	6.0	7.3	5.6
Left Little	3.9	2.5	5.3	6.1	4.7	5.6	6.4
No cases	19	16	27	15	46	42	32

* Previous study.

It was not feasible to give the comptometer test to the two-year-olds. Few children at this age could accomplish more than three or four taps with the middle finger. With the little finger, many could not depress the key far enough to register even a single tap. When the index finger was used they were fairly successful in unimanual tapping but had a

TABLE 4

Means and Standard Deviations of Bimanual Tapping With Comptometer by Age and Sex

	3½		4½		5½		5½*
	Boys	Girls	Boys	Girls	Boys	Girls	Both sexes
Means							
Right Index	23.1	23.4	30.2	28.7	33.0	35.2	28.6
Right Middle	17.9	16.4	25.8	23.8	27.7	37.5	30.1
Right Little	11.3	10.3	19.0	21.1	22.6	27.0	23.8
Left Index	11.6	14.8	18.9	18.6	20.4	22.1	22.6
Left Middle	11.0	11.6	17.1	17.2	18.7	20.1	21.5
Left Little	3.9	4.4	10.6	9.8	10.5	13.9	14.5
S. D.'s							
Right Index	8.2	11.2	6.4	7.0	8.2	9.6	8.6
Right Middle	7.3	8.3	7.3	7.4	8.4	7.2	8.3
Right Little	7.6	8.4	6.7	6.9	7.9	10.3	8.2
Left Index	4.3	7.6	6.8	9.8	7.9	6.5	9.0
Left Middle	4.6	5.7	4.4	7.8	9.0	7.0	7.6
Left Little	2.6	3.5	6.2	6.5	6.2	3.4	8.2
No. cases	19	16	27	15	46	42	32

* Previous study.

TABLE 5

Correlations Between Unimanual and Bimanual Tapping With Comptometer

FINGER	3½		4½		5½		5½*
	B	G	B	G	B	G	Both sexes
Right Index	+.10	+.27	+.54	+.79	+.40	+.30	+.72
Right Middle	+.24	+.47	+.55	+.48	+.27	+.48	+.69
Right Little	+.50	+.59	+.54	+.61	+.56	+.36	+.54
Left Index	+.12	+.69	+.11	+.66	+.26	+.45	+.76
Left Middle	+.53	+.68	+.14	+.65	+.19	+.42	+.59
Left Little	+.17	+.11	+.38	+.74	+.42	+.37	+.65
No. cases	19	16	27	15	46	42	32

* Previous study.

good deal of difficulty with bimanual tapping. Practically all the two-year-olds with whom it was tried found the task hard and uninteresting although the older children enjoyed it.

For these reasons it seemed best to discontinue the attempt to measure finger tapping at this age.

As with the stylus, the increase in speed of tapping between the ages of 3½ and 4½ is far greater than that occurring between the ages of 4½ and 5½. If we compare these data with the standards for adults which were obtained in the earlier study, we secure the results which are shown in Table 6.

TABLE 6

Percentage of Adult Speed of Tapping With Different Fingers Attained By Children at Successive Ages

(Comptometer tapping)

AGE	UNIMANUAL				BIMANUAL			
	3½	4½	5½	5½*	3½	4½	5½	5½*
Right Index	27.1	40.0	46.5	40.0	33.0	41.7	48.6	41.0
Right Middle	24.9	36.2	44.2	38.0	24.5	35.8	46.4	43.0
Right Little	18.4	29.5	38.7	34.0	16.3	30.8	37.3	36.0
Left Index	23.7	35.1	39.0	37.0	20.9	29.5	33.4	35.0
Left Middle	21.1	31.5	36.8	36.0	18.3	27.5	31.2	34.0
Left Little	11.9	21.7	28.8	26.0	7.7	19.0	22.1	26.0

* Previous study.

Interestingly enough, the differences between children and adults in the speed of the two hands takes a very different pattern in the case of the finger tapping from that shown in the stylus tapping. At all ages and for all fingers the children approach more closely to the adult performance when tapping with the right hand than when tapping with the left. In order to make sure that this was not simply a chance fluctuation of the particular sampling of adult subjects used,[4] we secured data on a second group of 60 adults, 30 of each sex, none of whom had been included in the first study. Tables 7–8 show the results of comparing child speed with adult speed when the findings from the new group of adults are taken as standards. (Compare Tables 2 and 6.)

[4] The fact that the same general tendency is shown by the children at all ages and for both sexes made it unnecessary to secure additional data for children, since the likelihood that a sampling error would take the same direction in each of seven to ten groups is very small.

TABLE 7

Percentages of Adult Speed Attained By Children at Different Ages

(Stylus tapping)

	AGE					
	Adult norm	2½	3½	4½	5½	5½*
Right hand	76.0	33.7	42.6	50.6	52.4	54.6
Left hand	67.7	35.0	44.2	51.9	56.7	57.5

* Previous study.

Tables 7 and 8 show the same general trends as do Tables 2 and 6. It seems unlikely, therefore, that the apparent difference in the developmental trends for hand dominance in tasks involving different muscle-groups is the result of a sampling error. An explanation is perhaps to be found in the fact that all our adult subjects were college students, practically all of whom were accustomed to the use of the typewriter and many of whom could play the piano—tasks which involve rapid and independent movements of the different fingers. If this explanation is the correct one, the reversal of the right-hand-left-hand ratios in the two forms of tapping is quite in accordance with the hypothesis that differential skill in the use of the two hands is in part a function of experience and training through which original tendencies toward laterality of function may either be increased (as our data suggest has been the case with the type of movement required by the stylus tapping) or decreased (as seems to have been true in the finger tapping).

Forty-five children were retested after an interval of one year. The correlation between the scores on the stylus tapping (sum of the two trials given on each occasion) was .45 for the right hand and .55 for the left. With age held constant by partial correlation, these figures reduce to .35 and .42 respectively. For the comptometer tapping, the correlation between the combined scores for the different fingers by the two methods (unimanual and bimanual) after the year's interval was found to be .71 for the right hand and .22 for the

TABLE 8

Percentage of Adult Speed of Tapping With Different Fingers Attained By Children at Successive Ages

(Comptometer tapping)

FINGER	UNIMANUAL					BIMANUAL				
	Adult norm	3½	4½	5½	5½*	Adult norm	3½	4½	5½	5½*
Right Index	69.8	27.4	40.1	47.1	40.3	66.5	35.0	44.4	57.3	43.0
Right Middle	68.7	26.2	39.3	46.7	39.7	66.0	25.9	37.6	49.4	45.6
Right Little	64.0	19.8	32.3	41.6	36.7	60.5	17.8	33.2	40.5	39.3
Left Index	61.7	24.0	35.5	39.9	37.8	57.9	22.8	32.3	36.8	39.0
Left Middle	60.2	21.7	32.6	38.0	37.0	57.5	19.7	29.9	33.7	37.4
Left Little	53.9	12.4	22.6	30.4	27.8	49.7	8.4	20.5	24.5	29.2

* Previous study.

left, when age is held constant. Twenty-two children were tested again after an interval of two years from the time of the first test. With age constant the correlations between scores on the first and final tests were practically zero for both kinds of tapping. It appears, therefore, that while individual differences in speed of tapping show some tendency to persist over a period of a year, the predictive value of such tests does not extend very far into the child's future, at least when the tests are given during the preschool period.

Correlations were also computed between the scores earned on the stylus tapping and those earned on the comptometer tapping for ages and sexes separately, keeping the hands separate but combining the trials for the different fingers and methods as described in the foregoing paragraph. The results, which are shown in Table 9, suggest a much greater degree of specificity of the two forms of tapping than naïve consideration might lead one to expect, although they are in line with results obtained by other investigators which have in general tended to show that motor skills are specific rather than general.

TABLE 9

Correlations Between Scores Earned in Tapping With Stylus and Combined Scores on Tapping With Comptometer

	3½		4½		5½		5½*
	Boys	Girls	Boys	Girls	Boys	Girls	Both sexes
Right hand	+.13	+.56	−.10	+.15	+.19	+.39	+.70
Left hand	−.01	−.01	+.27	+.55	−.21	+.18	+.60
N	19	16	27	15	46	42	32

* Previous study.

SUMMARY

1. A study of the speed of tapping by two methods (tapping with stylus on a metal plate and finger tapping on a key-drive adding machine) which was carried out with 240 children between the ages of 2½ and 5½ years shows that for both forms of tapping the curve of growth shows marked

negative acceleration. Between the ages of 2½ and 4½ the annual gain in speed is more than twice as great as that occurring between the ages of 4½ and 5½.

2. This study confirms the results of an earlier one in showing that the order of functional development is from large-muscle to small-muscle groups. At every age studied, the children are nearest the adult level in the forms of tapping that make chief demand upon the larger muscles of the arm and wrist. In the finger tapping the order of functional maturity is in every case: index finger first, then the middle finger, while the little finger lags appreciably behind the others not simply in absolute speed but in proportion to that attained by the adult.

3. In tapping with the stylus which involves a wrist movement not closely resembling any of the motor skills which are likely to be much practiced in later life, the children are slightly nearer the adult level in tapping with the left hand than with the right. In the finger tapping, however, a task which is closely related to such adult bimanual skills as typewriting and piano playing, the children are nearer the adult level of speed in tapping with the right hand than in tapping with the left. This suggests that laterality of function, while present even in early childhood, becomes distinctly modified by differential practice as age advances.

4. Correlations between tapping scores by different methods, while in general positive, are not very high. This is in accordance with findings of other investigators who have commonly reported rather low intercorrelations between motor skills, even though the tasks set bear a good deal of superficial resemblance to each other.

5. Individual differences in speed of tapping show some tendency to persist over a period of several months. Correlations between original scores and retest scores of the same children after an interval of one year are positive but not very high. After a two-year interval the correlations between original test and retest have become practically zero. The youth of the subjects at the time of the first test must be taken into consideration in interpreting these findings.

THE INFLUENCE OF COLOR BLINDNESS ON INTELLIGENCE AND ACHIEVEMENT OF COLLEGE MEN[1]

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THIS study was conducted during the school year of 1932–1933 among the day session men students of The University of Toledo. Its purpose was to attempt to answer two questions. First, do color-blind college men have higher or lower intelligence than normal (non-color-blind) college men? Second, is the school achievement of color-blind college men higher or lower than of normal college men?

Sixty-four women were examined at the beginning of this study but no cases of color blindness were found. Since other studies have found such a small percentage of women with color blindness it was decided to confine the present study to men students alone.

Miles (5, p. 537) reported that out of 436 women examined with the Ishihara test at Stanford University only one case of color blindness was found. Only three other women made one mistake each. Garth (3, Table I) found only three cases of color blindness among 232 unselected white women tested.

The only test for color blindness used in the present study was the Ishihara test (4). It was not the purpose of this study to determine specific facts concerning each individual's defect, but merely to recruit a group of color-blind subjects. For this reason the eyes of each subject were not tested separately. Had this been done, it is probable that no difference would have been found. Garth (3), in his study of incidence of

[1] This is a revision and summary of a study made by Alice B. Lorenz under the direction of W. E. McClure entitled, "Color Blindness in Relationship to Intelligence and Achievement," unpublished, in the University of Toledo Library. This manuscript contains a bibliography of 89 articles and studies on color blindness.

color blindness among races tested each eye separately of 211 color-blind subjects (both men and women) but found no case of monocular color blindness.

The Ishihara test has been highly praised by several investigators who have given it a fair trial. Clark (1), after presenting results of studies made with the Edridge-Green Card Test and Stilling's Pseudo-Isochromatic Plates as well as with the Ishihara test, states, "The ingenuity and simplicity of the Ishihara test, and the clear-cut results obtained with it in practice, make it, to my mind, the most successful of the various color blindness tests." Clements (2), in commenting on tests for color blindness using figures on pseudo-isochromatic cards, says, "The best-known tests of this type are those of Stilling and Ishihara." In the same article he refers to a study made by P. von Planta, published in a German Ophthalmological journal in 1928 and says, "Von Planta compared results obtained by several of these tests with those given by the anomaloscope and concluded that the series devised by Ishihara was the most satisfactory."

In the present study 811 men students were examined for color blindness. All of the 16 Ishihara plates were shown to each student. The test was administered according to the directions given by the author. A well lighted room was used. None of the subjects were asked to name the specific colors in the test.

The 811 men were divided into three groups according to their ability to pass the test, *e.g.*, those making no mistakes, those making minor mistakes but not counted in the color-blind group, and those found to be definitely color-blind. Some in the second group who made as many as three or four mistakes might be called borderline cases but with a defect not definite enough to be classed as color-blind.

The following summary shows the number of men classed in each group.

I. Number of men making no mistakes on the test	548
II. Number of men making minor mistakes but not classed as color-blind	190

1—One mistake	138	
2—Two mistakes	46	
3—Three or four mistakes	6	
III. Number of men definitely color-blind		73
Total number of men tested		811

According to Ishihara (4, in introduction), "congenital colour-blindness is of two kinds: total colour-blindness and red-green-blindness, and these have each two forms: complete and incomplete." He divides red-green-blindness into red-blindness and green-blindness.

Using the classification given by Ishihara, our 73 cases of color blindness were separated into the various types. The following classification shows the number of men having each kind of color blindness.

1. Complete total color blindness	0
2. Incomplete total color blindness	2
3. Complete red-green-blindness	17
4. Incomplete red-green-blindness	33
5. Complete red-blindness, seeing green	0
6. Incomplete red-blindness	0
7. Complete green-blindness, seeing red	21
8. Incomplete green-blindness	0
Total cases of color blindness	73

The two summaries presented above show that out of 811 men examined, 548 made no mistakes on the test, 190 made minor errors but were not sufficiently deficient to be classed as color-blind, while 73 were found to be definitely color-blind. No cases of complete total color blindness were found. Nor were any cases of the following types found: complete red-blindness, seeing green; incomplete red-blindness; incomplete green-blindness. The types found in order of frequency were: incomplete red-green-blindness, 33 cases; complete green-blindness, seeing red, 21 cases; complete red-green-blindness, 17 cases; incomplete total color blindness, 2 cases.

Of the 811 men examined, 9.0 per cent were color-blind. This per cent is slightly higher than reported by some other investigators using the same test, although it compares quite

favorably with them. Garth (3) reported 8.4 per cent of 795 unselected white males as being color-blind. Miles (5) reported the results of three studies as follows: in 1926 Haupt examined 448 boys, 7 to 16 years of age and found 35 color-blind, or 7.8 per cent; in 1927 Miles examined 590 university men and found 48 color-blind, or 8.1 per cent; in 1928 Miles examined 696 university men and found 58 color-blind, or 8.3 per cent.

TABLE I
Color-blind men according to classes

CLASS	TOTAL NUMBER IN EACH CLASS	TOTAL NUMBER EXAMINED	COLOR-BLIND NUMBER	COLOR-BLIND PER CENT
Freshman	410	300	38	12.67
Sophomore	256	202	14	6.93
Junior	178	152	10	6.58
Senior	161	129	11	8.52
Graduate	53	27	0	0.00
Special	4	1	0	0.00
Total	1062	811	73	9.00

Table I shows the distribution of the men examined in the present study according to classes and the number and percentages of color-blind in each class. It shows 300 freshmen examined, 38 color-blind, 12.67 per cent; 202 sophomores examined, 14 color-blind, 6.93 per cent; 152 juniors examined, 10 color-blind, 6.58 per cent; 129 seniors examined, 11 color-blind, 8.52 per cent; 27 graduates examined, none color-blind; 1 special student examined, normal vision.

It is interesting to note the large percentage found in the freshman class as compared with the other classes, almost twice as large as in either the sophomore class or the junior class. It is also interesting to note that none of the 27 graduate students were color-blind. Since this study covered only one academic year and because of the small number of cases used, it cannot be concluded that color-blind students, as they progress from the freshman year to the graduate school, drop out

of the university in larger proportions than do the non-color blind students. However, further investigation may find this to be the case.

Do color-blind college men have higher or lower intelligence than do non-color-blind college men?

In attempting to answer this question the scores made on the Ohio State University Psychological Test by the two groups of men were compared. This test is required of entering freshmen, but since all of the students of the various classes in

TABLE II

Frequency of raw scores made by the color-blind and the non-color-blind men on the Ohio State University Psychological Test

SCORES	COLOR-BLIND	NON-COLOR-BLIND
250–259	0	1
240–249	0	1
230–239	0	0
220–229	0	1
210–219	0	1
200–209	0	2
190–199	0	9
180–189	2	9
170–179	3	10
150–159	2	13
160–169	4	20
140–149	4	24
130–139	12	40
120–129	6	53
110–119	4	57
100–109	5	63
90– 99	5	71
80– 89	8	85
70– 79	7	61
60– 69	4	57
50– 59	3	53
40– 49	1	18
30– 39	0	3
20– 29	0	1
Total	70	653
Mean	113.29 ± 2.84	101.9 ± 0.96

the university had not taken the same form of the test it was necessary to make their scores comparable by using a reduction scale by which scores on all the Ohio State University Psycho-

logical Tests can be interpreted as though pertaining to Form 17.[2]

Table II shows the frequency distribution of the raw scores made on the Ohio State University Psychological Test by both the color-blind and the non-color-blind men. These test scores were available for only 70 of the color-blind and 653 of the non-color-blind. The mean score for the color-blind is shown to be 113.29 and for the non-color-blind, 101.9, a difference of 11.39 points. These results cannot be taken as conclusive evidence that the color-blind are superior to the non-color-blind since the former group is so much smaller than the latter. However, there is an indication that the color-blind do not have inferior mental ability.

When the men were grouped according to classes, *e.g.*, freshmen, sophomores, juniors, and seniors, it was found that the color-blind freshmen and seniors were much higher than the sophomores and juniors on their test scores. (See Table III.) The color-blind freshmen were 13.26 points higher than the

TABLE III

Mean scores made by the color-blind and the non-color-blind men on the Ohio State University Psychological Test according to classes

CLASS	NUMBER OF COLOR-BLIND MEN	MEAN SCORE OF COLOR-BLIND MEN	NUMBER OF NON-COLOR-BLIND MEN	MEAN SCORE OF NON-COLOR-BLIND MEN	DIFFERENCE
Freshman	37	117.97	240	104.71	13.26
Sophomore	14	100.00	166	98.19	1.81
Junior	10	106.00	136	102.50	3.50
Senior	9	122.78	111	100.68	22.10
Total	70	113.29	653	101.9	11.39

non-color-blind freshmen and the color-blind seniors were 22.10 points higher than the non-color-blind seniors. In the spohomore and junior years the two groups had more equal scores,

[2] This scale was furnished by the Administrative Office of the University of Toledo. It had been computed from scores made in Toledo on different forms of the Ohio State University Psychological Tests.

the color-blind being higher by only 1.81 points and 3.50 points respectively. Thus, in each year the color-blind had higher scores than the non-color-blind.

Table IV compares the standard deviations of the means of the Ohio State University Psychological Test scores made by the color-blind and non-color-blind men grouped according to classes. In each case except in the senior class the color-blind showed a greater degree of concentration about the point of central tendency than the non-color-blind.

TABLE IV

Standard deviations of the means of the psychological test scores for the color-blind and the non-color-blind

CLASS	NUMBER COLOR-BLIND	S.D. COLOR-BLIND	NUMBER NON-COLOR-BLIND	S.D. NON-COLOR-BLIND
Freshman	37	32.9 ± 2.58	240	35.9 ± 1.11
Sophomore	14	32.0 ± 4.08	166	36.7 ± 1.36
Junior	10	29.8 ± 4.49	136	38.7 ± 1.59
Senior	9	46.3 ± 7.36	111	33.3 ± 1.52
Total	70	35.3 ± 2.02	653	36.4 ± 0.68

Is the school achievement of color-blind college men higher or lower than of non-color-blind college men?

In attempting to answer this question the point average made by each man in the first semester of the freshman year (regardless of classification at the time the study was made) was used as the unit of achievement. The means of the point averages of the color-blind and the non-color-blind men were compared. The point system used at the University of Toledo is as follows:

GRADE EARNED	POINTS EARNED
A	3
B	2
C	1
P (lowest passing grade)	0
F (failure)	−1
I (incomplete)	0
D (condition)	0
W.P. (withdraw with passing)	0
W.F. (withdraw with failing)	−1

The directions for computing the average point score are: "Divide the total number of hours registered by the student into the number of points earned; however, do not include in the hours registered the W.P. grades nor the I grades."

Thus, a student who registers for 18 hours of work and makes all A's will earn an average point score of 3.00, or if he makes all P's he will earn an average point score of 0.00. But should he fail in a course or withdraw from it after doing failing work (W.F. grade), one point for each of the hours that class meets per week would be deducted from the total number of points earned in each of the other courses.

Since the point average scores were obtained during the second semester of the school year, the only scores available for the freshmen were those earned during the first semester. Thus, in order that all scores might be comparable for all classes, only those made by the men in the other classes during the first semester of their freshman year were used in the present study.

TABLE V

Frequency of average point scores earned by the color-blind and the non-color-blind men in the first semester of their freshman year

AVERAGE POINT SCORE	NUMBER OF COLOR-BLIND	NUMBER OF NON-COLOR-BLIND
2.50 – 2.99	1	32
2.00 – 2.49	8	55
1.50 – 1.99	7	95
1.00 – 1.49	20	145
0.50 – 0.99	13	145
0.00 – 0.49	12	118
–0.50 – –0.01	9	39
–1.00 – –0.51	1	15
Total	71	644
Mean score	0.95	1.05

Table V shows the frequency distribution of the average point scores earned by the color-blind and the non-color-blind men. The mean scores for the two groups are 0.95 and 1.05, respectively. The achievement, then, of the non-color-blind is

slightly higher than that of the color-blind, the difference being 0.10. However, the difference is so small that it could be considered almost negligible. In terms of letter grades, the color-blind group made an average grade of slightly below C, while the non-color-blind group made an average grade of slightly above C. The grade of C is approximately the average grade earned throughout the university.

TABLE VI

Means of the average point scores of the color-blind and the non-color-blind men according to classes

CLASS	NUMBER COLOR-BLIND	MEAN COLOR-BLIND	NUMBER NON-COLOR-BLIND	MEAN NON-COLOR-BLIND	DIFFERENCE
Freshman	36	0.89	233	0.95	0.06
Sophomore	14	0.82	166	1.05	0.23
Junior	10	0.85	135	1.10	0.25
Senior	11	1.43	110	1.22	0.21
Total	71	0.95	644	1.05	0.10

Table VI shows the means of the average point scores of the two groups according to classes. The non-color-blind exceed the color-blind in all but the senior year. The average point scores for the color-blind are: freshman, 0.89; sophomores, 0.82; juniors, 0.85; seniors, 1.43. For the non-color-blind they are: freshmen, 0.95; sophomores, 1.05; juniors, 1.10; seniors, 1.22. The highest average for both groups is in the

TABLE VII

Standard deviations of the means of the average point scores for the color-blind and the non-color-blind

CLASS	NUMBER COLOR-BLIND	S.D. COLOR-BLIND	NUMBER NON-COLOR-BLIND	S.D. NON-COLOR-BLIND
Freshman	36	.805 ± .064	233	.825 ± .026
Sophomore	14	.775 ± .099	166	.820 ± .030
Junior	10	.535 ± .081	135	.810 ± .033
Senior	11	.830 ± .119	110	.750 ± .034
Total	71	.795 ± .045	644	.810 ± .015

senior year. The lowest average for the color-blind is in the sophomore year, while for the non-color-blind group it is in the freshman year.

Table VII shows a comparison of the standard deviations of the means of the average point scores for the two groups according to classes. The color-blind show a greater concentration about the point of central tendency in all but the senior year. Comparing the totals for the two groups, the 71 color-blind men have a greater concentration than the 644 non-color blind men, the standard deviations being .795 and .810 respectively.

The coefficient of correlation between the psychological test scores and the average point scores for the color-blind is .43 and for the non-color-blind, .51. Since the number of color-blind subjects is so small the correlations are not presented for each class separately.

SUMMARY

1. Out of 811 men given the Ishihara Test at the University of Toledo during the school year of 1933–1934, 73 were found to be color-blind, or 9 per cent. Grouped according to classes the percentages were found to be: freshmen, 12.67; sophomores, 6.93; juniors, 6.58; seniors, 8.52; graduates, 0.00.

2. The mean score on the psychological test was higher for the color-blind (113.29) than for the non-color-blind (101.9). Furthermore, in each class the color-blind had a higher mean score than the non-color-blind.

3. The achievement for the color-blind in terms of average point scores was slightly lower than for the non-color-blind, 0.95 and 1.05 respectively. In the senior class, however, the color-blind excelled the non-color-blind.

4. The correlation between psychological test scores and achievement was .43 for the color-blind and .51 for the non-color-blind.

CONCLUSIONS

This study shows that the color-blind men had a higher general intelligence rating than the non-color-blind men, but in

general achievement the former group was slightly lower than the latter.

Since the color-blind group was small, no generalizations can be made, but in so far as the students included in this study are concerned, it can be said that color-blind men are not handicapped either in mental ability or school achievement. It is quite probable that, had the two groups been equal in size, *e.g.*, if the color-blind group had been as large as the non-color-blind group, the difference between them would have been reduced.

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THE PERFORMANCE OF A GROUP OF COLLEGE STUDENTS ON THE KWALWASSER–DYKEMA MUSIC TESTS

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PURPOSE OF THIS STUDY

THE present study was undertaken to examine the performance of a group of college students on the Kwalwasser-Dykema Music Tests and to compare the performance of these college students with that of the elementary and high school pupils on whom the tests have been standardized. While they have been developed for use in the public schools, primarily (3), preliminary trials indicated the possibility that the musical performance of college students might also be measured by these tests.

DESCRIPTION OF THE TESTS

The Kwalwasser-Dykema Music Tests (4) consist of five ten-inch phonograph records. Each of the records contains two tests. The tests are: 1. Tonal Memory, 2. Quality Discrimination, 3. Intensity Discrimination, 4. Tonal Movement, 5. Time Discrimination, 6. Rhythm Discrimination, 7. Pitch Discrimination, 8. Melodic Taste, 9. Pitch Imagery, and 10. Rhythm Imagery. Four of these tests "are of the sensory or discriminative type," according to Moos (6), "the remaining six being supersensory or aesthetic." Moos believes that the Kwalwasser-Dykema test series "as a whole unquestionably marks a long forward stride on the road of music testing." Mursell and Glenn (8) commend these tests because they use actual musical material, because they are short and are interesting. The directions for administering the tests and the musical notation of each are contained in the *Manual of Direc-*

tions (5). Each person who takes the tests is provided with a standard test blank on which he records his response to each item.

SUBJECTS AND PROCEDURE

The subjects in the present study were five hundred college students, sophomores and juniors, in psychology classes at New York University and at Long Island University.[1] In the administration of the tests, the procedure followed was that given in the Manual.

RESULTS

The mean, standard deviation, coefficient of variation, and retest coefficient of each of the tests and of the total score are shown in Table 1. The first three computations are based on the scores made by the total group of five hundred students. Of this group of students, only a small proportion made a perfect score on any of the tests. This fact indicates that it is entirely feasible to test the musical aptitude and achievement of adult students by means of this kind of test. An examination of Table 1 will show that these college students made mean scores on all the tests that are considerably above the middle of the range of items. For example, in Test 1 (Tonal Memory), the number of items is twenty-five; the mean of these students on this test is 18.48. In Test 7 (Pitch Discrimination), the number of items is forty; the mean of the present group is 27.36. This tendency of the scores to group toward the upper end of the range of items suggests that these tests may not be difficult enough for the present group.

When the mean scores of these students are compared with the mean scores of school children reported by Kwalwasser (3), it is found that the present group have mean scores on each of the tests and on the total score that are higher than those made by the school children. For example, on Test 1 (Tonal Memory), the school children (2,530 girls, 5 to 18 years of age), made a mean score of 16.05, compared with a mean score

[1] The authors gave the tests to students at Long Island University through the kindness of Professor Richard H. Paynter.

of 18.48 made by these college students. On the total score, the school children (girls) made a mean score of 182.05, compared with the college students' mean score of 199.56.

TABLE 1

Mean, Standard Deviation, Coefficient of Variation, and Retest Coefficient of Each of the Tests and of the Total Score

Test	MEAN (N = 500)	S.D.	C.V.	RETEST COEFFICIENT r (N = 101)	PE_r
1. Tonal Memory	18.48 ± .10	3.24	17.55	.7268	± .0317
2. Quality Discrimination	23.51 ± .08	2.54	10.82	.3191	± .0603
3. Intensity Discrimination	23.66 ± .07	2.16	9.12	.0511	± .0669
4. Tonal Movement	19.04 ± .19	6.15	32.32	.6872	± .0355
5. Time Discrimination	18.86 ± .08	2.66	14.08	.4253	± .0550
6. Rhythm Discrimination	19.19 ± .07	2.18	11.34	.4758	± .0520
7. Pitch Discrimination	27.36 ± .10	3.37	12.33	.1780	± .0650
8. Melodic Taste	15.47 ± .08	2.66	17.19	.5203	± .0489
9. Pitch Imagery	15.35 ± .08	2.76	17.98	.4544	± .0533
10. Rhythm Imagery	18.66 ± .08	2.52	13.50	.3824	± .0573
TOTAL SCORE	199.56 ± .46	15.37	7.70	.6901	± .0351

The standard deviations and coefficients of variation in Table 1 show that these tests differ considerably in variability. The least variable is Test 3 (Intensity Discrimination); in this test the coefficient of variation is 9.12. Test 4 (Tonal Movement) is the most variable; the coefficient of variation of this test is 32.32. When the coefficients of variation of the present group are compared with the coefficients of variation of the school children (calculated from Kwalwasser's data), it is found that, with the exception of Test 4 (Tonal Movement) and Test 9 (Pitch Imagery), these college students are somewhat less variable on these tests than are the school children. On the total score, the coefficient of variation of the college students is 7.70; that of the children (girls) is 9.20. The average coefficient of variation of the students is 15.62; that of the children (girls) is 17.18.

RETEST COEFFICIENTS OF THE TESTS

The tests were given twice to a random sample of the total population, consisting of one-hundred one students. The correlations between the test scores and the retest scores have been computed. These retest coefficients (Table 1) range from $r = .0511$ (Intensity Discrimination) to $r = .7268$ (Tonal Memory). Because of the tendency to repeat responses given previously, retest coefficients, according to Kelly (2), tend to be higher than coefficients of reliability determined by the split-test method.

In a critical comparative study of the Seashore tests and eight of the Kwalwasser-Dykema tests, Whitley (14) reports reliability coefficients obtained by the split-test method and the use of the Spearman-Brown formula. The reliability coefficients given by Whitley for the Kwalwasser-Dykema tests studied range from $r = .219$ (Melodic Taste) to $r = .830$ (Tonal Movement). Retest coefficients for the Kwalwasser-Dykema tests are reported by Sanderson (9) in a study of "differences in musical ability in children of different national and racial origin." In a group of seventy-six Polish children, Sanderson's coefficients range from $r = .07$ (Intensity Discrimination) to $r = .57$ (Tonal Movement). In a group of seventy-four Jewish children, Sanderson's coefficients range from $r = .04$ (Rhythm Discrimination) to $r = .51$ (Tonal Memory). The same author finds that the retest coefficient of the total score is $r = .61$ among the Polish group and $r = .48$ among the Jewish group.

In view of the retest coefficients found in this study and the coefficients of reliability reported by other investigators, it would seem that these tests, like the Seashore tests, should be used in individual diagnosis with great caution. It has been suggested by Stanton (11) that the Seashore tests may be used as aids in the administrative procedure of a school of music. A similar use in the testing of groups of students can undoubtedly be made of the Kwalwasser-Dykema tests.

TABLE 2

Intercorrelations Among the Kwalwasser-Dykema Music Tests

N = 452

	2	3	4	5	6	7	8	9	10
1. Tonal Memory	.2762	.1209	.3675	.1529	.3179	.1760	.1490	.2770	.2943
2. Quality Discrimination		.0970	.1370	.1378	.1787	.0974	.0075	.1097	.2206
3. Intensity Discrimination			.0931	.1348	.0148	.0089	.0836	.0515	.1325
4. Tonal Movement				.0043	.1039	.0800	.0871	.2676	.3203
5. Time Discrimination					.1461	.0509	.0990	.0066	.0056
6. Rhythm Discrimination						.1213	.1412	.0821	.1754
7. Pitch Discrimination							.0723	.0000	.0309
8. Melodic Taste								.0923	.2116
9. Pitch Imagery									.2683

INTERCORRELATIONS AMONG THE TESTS

The correlations of each test with every other test in the Kwalwasser-Dykema series are presented in Table 2. These correlations range from zero (Pitch Discrimination and Pitch Imagery) to $r = .3675$ (Tonal Memory and Tonal Movement). Weaver (13) has published the intercorrelations among the Seashore tests, using the scores made by two-hundred ten men college students. The coefficients obtained by Weaver range from $r = .2018$ (Intensity and Tonal Memory) to $r = .7780$ (Pitch and Consonance). In his critical study of the Seashore-Kwalwasser battery,[2] Farnsworth (1) reported intercorrelations which range from $r = .02$ (Intensity and Melody, Intensity and Harmony, Time and Harmony) to $r = .50$ (Pitch and Tonal Memory). Mursell (7), who gave the Seashore tests to one hundred seventy-six college students, found coefficients that ranged from $r = .085$ (Time and Consonance) to $r = .55$ (Memory and Consonance).

The intercorrelations among the Kwalwasser-Dykema tests found in the present group of college students are lower than those reported for the Seashore tests by Weaver, by Farnsworth and by Mursell. The finding of the present study supports the view that the musical aptitudes and achievements measured by these tests in this group of students, are, to a very large extent, independent variables. That is to say, musical ability, to the extent that it is measured by these tests, is not a unitary ability, but is, rather, a complex of several separate abilities each of which may vary independently of the others.

PERCENTILE RANKS

The performance of the children on whom these tests have been standardized has been expressed in the Manual (5) in terms of percentile ranks. Tables 3 to 6 of the present study contain the percentile ranks of this group of five hundred college students. In order to make comparisons between the

[2] The Kwalwasser tests studied by Farnsworth are not part of the present Kwalwasser-Dykema series.

TABLE 3

Test I. Tonal Memory

Score	Percentile Rank Men	Women	Total Group
25	.995	.986	.993
24	.960	.956	.958
23	.905	.882	.896
22	.846	.798	.825
21	.781	.733	.760
20	.712	.642	.682
19	.609	.540	.579
18	.477	.421	.453
17	.356	.289	.327
16	.251	.193	.226
15	.160	.121	.143
14	.100	.068	.081
13	.063	.033	.050
12	.039	.012	.027
11	.016	.005	.011
10	.002	.005	.003
9	.....	.003	.001
8		.....	.....

Test II. Quality Discrimination

Score	Percentile Rank Men	Women	Total Group
30	.998	.....	.999
29	.989	.998	.993
28	.967	.974	.970
27	.909	.923	.915
26	.795	.851	.819
25	.672	.747	.704
24	.549	.582	.563
23	.402	.414	.407
22	.272	.282	.276
21	.168	.175	.171
20	.095	.103	.101
19	.058	.047	.053
18	.021	.016	.019
17	.004	.005	.004
16	.....	.....	.....

Test III. Intensity Discrimination

Score	Percentile Rank Men	Women	Total Group
30	.....	.....	.....
29	.998	.....	.999
28	.977	.998	.997
27	.977	.974	.976
26	.895	.900	.897
25	.743	.752	.736
24	.523	.514	.519
23	.307	.291	.300
22	.169	.164	.162
21	.088	.077	.083
20	.053	.042	.048
19	.039	.026	.033
18	.032	.019	.026
17	.023	.012	.016
16	.011	.009	.010
15	.007	.009	.008
14	.006	.009	.007
13	.004	.009	.006
12	.002	.005	.003
11	.....	.....	.....

Test IV. Tonal Movement

Score	Percentile Rank Men	Women	Total Group
30	.998	.996	.997
29	.982	.930	.964
28	.947	.856	.908
27	.907	.798	.860
26	.874	.749	.820
25	.841	.696	.778
24	.805	.647	.737
23	.775	.600	.700
22	.744	.542	.657
21	.707	.491	.614
20	.658	.432	.565
19	.600	.389	.509
18	.549	.333	.456
17	.488	.281	.399
16	.425	.230	.341
15	.370	.177	.287
14	.326	.135	.244
13	.284	.098	.204
12	.236	.068	.163
11	.184	.049	.126
10	.112	.033	.078
9	.046	.014	.032
8	.018	.005	.012
7	.009	.003	.006
6	.002	.....	.001
5	.....		.....

TABLE 4

Test V. Time Discrimination

Score	Percentile Rank Men	Women	Total Group
25	.998	____	.999
24	.988	.996	.991
23	.956	.977	.965
22	.872	.928	.896
21	.748	.823	.780
20	.605	.665	.631
19	.449	.500	.471
18	.318	.347	.330
17	.215	.231	.221
16	.141	.169	.148
15	.100	.102	.099
14	.067	.075	.064
13	.035	.030	.033
12	.014	.005	.010
11	.004	____	.002
10	____		____

Test VI. Rhythm Discrimination

Score	Percentile Rank Men	Women	Total Group
25	____	____	____
24	.998	.998	.998
23	.988	.981	.985
22	.828	.923	.926
21	.795	.772	.785
20	.611	.579	.597
19	.435	.410	.422
18	.304	.240	.276
17	.179	.126	.156
16	.090	.070	.085
15	.050	.037	.044
14	.025	.021	.023
13	.015	.012	.013
12	.008	.003	.005
11	.004	____	.002
10	.002		.001
9	____		____

Test VII. Pitch Discrimination

Score	Percentile Rank Men	Women	Total Group
40			
39			
38	____		____
37	.997		.998
36	.993	____	.996
35	.986	.998	.991
34	.976	.993	.983
33	.958	.979	.967
32	.919	.949	.932
31	.867	.893	.873
30	.774	.812	.790
29	.665	.707	.683
28	.536	.570	.550
27	.413	.423	.417
26	.307	.302	.305
25	.219	.214	.217
24	.161	.154	.158
23	.104	.112	.107
22	.055	.079	.065
21	.035	.058	.045
20	.021	.040	.029
19	.007	.026	.015
18	____	.021	.009
17		.014	.006
16		.007	.003
15		.003	.001
14		____	____

Test VIII. Melodic Taste

Score	Percentile Rank Men	Women	Total Group
20	.970	.986	.977
19	.911	.937	.922
18	.814	.833	.822
17	.700	.691	.696
16	.576	.520	.547
15	.426	.347	.392
14	.283	.235	.262
13	.176	.145	.162
12	.104	.089	.103
11	.074	.049	.063
10	.046	.031	.039
9	.023	.026	.024
8	.009	.019	.013
7	.004	.010	.006
6	.002	.003	.002
5	____	____	____

TABLE 5

Test IX. Pitch Imagery				*Test X. Rhythm Imagery*			
	Percentile Rank				*Percentile Rank*		
Score	Men	Women	Total Group	Score	Men	Women	Total Group
25	.997	.998	.997	25	.....	.....	.....
24	.988	.993	.990	24	.997	.993	.995
23	.979	.991	.988	23	.974	.972	.973
22	.970	.989	.986	22	.926	.913	.916
21	.958	.963	.960	21	.849	.761	.811
20	.937	.924	.931	20	.734	.598	.675
19	.907	.874	.895	19	.602	.435	.530
18	.857	.819	.841	18	.449	.279	.376
17	.800	.717	.765	17	.307	.156	.242
16	.716	.582	.658	16	.200	.075	.146
15	.564	.428	.505	15	.125	.035	.086
14	.381	.265	.331	14	.078	.019	.052
13	.204	.137	.175	13	.036	.012	.025
12	.098	.061	.082	12	.013	.007	.010
11	.046	.028	.038	11	.004	.003	.003
10	.013	.007	.010	10	.....	.....	.....
9	.004	.005	.004				
8	.002	.005	.003				
7	.....	.003	.001				
6		.....	.....				

performance of the men and that of the women subjects, the percentile ranks of the men and of the women have been computed separately in addition to the ranks of the college students as a total group. The upper quartile, the median, and the lower quartile of the men, of the women, and of the total group are in Table 7. When the percentile ranks in Tables 3 to 6 are compared with the percentile ranks in the Manual, it it found that these students make higher scores on the individual tests and on the total series than do the children.

In his study of "the predictive value of music talent tests for teacher-training purposes," Tilson (12) found that the scores made on the Kwalmasser-Dykema tests by a group of adult students who were specializing in music, clustered around the upper percentiles reported in the Manual. The present study and that made by Tilson agree in finding that older persons tend to make higher scores on these tests than those made by children. This difference between the performance of adults and that of children has been recognized by Seashore, who has three sets of percentile ranks for his

TABLE 6

Score	Total Score — Percentile Rank Men	Women	Total Group	Score	Total Score — Percentile Rank Men	Women	Total Group
243	.....		.....	200	.593	.447	.530
242	.997		.998	199	.570	.414	.503
241	.997		.996	198	.541	.379	.471
240	.997		.996	197	.518	.356	.448
239	.997		.996	196	.507	.338	.430
238	.991		.995	195	.478	.308	.400
237	.989		.994	194	.439	.277	.369
236	.989	.....	.994	193	.415	.259	.347
235	.989	.993	.991	192	.385	.240	.322
234	.989	.986	.988	191	.353	.228	.299
233	.988	.986	.987	190	.328	.212	.278
232	.988	.982	.984	189	.295	.191	.250
231	.984	.977	.981	188	.262	.174	.224
230	.977	.975	.976	187	.246	.163	.210
229	.970	.972	.971	186	.235	.149	.198
228	.967	.969	.968	185	.227	.133	.186
227	.963	.963	.963	184	.211	.119	.171
226	.961	.956	.959	183	.191	.105	.146
225	.954	.944	.950	182	.169	.098	.138
224	.940	.926	.934	181	.142	.093	.121
223	.930	.909	.921	180	.125	.086	.108
222	.923	.900	.913	179	.106	.084	.096
221	.916	.886	.903	178	.092	.072	.083
220	.911	.865	.891	177	.079	.054	.068
219	.907	.849	.882	176	.069	.042	.057
218	.904	.831	.872	175	.060	.037	.050
217	.900	.807	.860	174	.051	.037	.045
216	.891	.793	.849	173	.046	.035	.041
215	.877	.784	.837	172	.041	.033	.037
214	.865	.768	.823	171	.039	.028	.034
213	.851	.740	.803	170	.033	.021	.028
212	.832	.703	.776	169	.027	.017	.022
211	.811	.679	.754	168	.020	.012	.016
210	.791	.670	.739	167	.014	.007	.011
209	.772	.649	.719	166	.014	.003	.009
208	.758	.626	.701	165	.014	.....	.008
207	.746	.598	.682	164	.011		.006
206	.730	.559	.656	163	.006		.003
205	.714	.530	.635	162	.004		.002
204	.690	.514	.614	161	.004		.002
203	.658	.503	.591	160	.004		.002
202	.635	.486	.571	159	.002		.001
201	.616	.465	.551	158	.....		.....

tests: one set at the fifth-grade level, another at the eighth-grade level and a third at the adult level. The fact that adults make higher scores on music tests than do children is explained by Seashore (10) as due to differences of a cognitive or infor-

TABLE 7

Upper Quartile, Median, and Lower Quartile of Each of the Tests and of the Total Score

	MEN SUBJECTS (N = 285)			WOMEN SUBJECTS (N = 215)			TOTAL GROUP (N = 500)		
	Q_3	Median	Q_1	Q_3	Median	Q_1	Q_3	Median	Q_1
1. Tonal Memory	20.45	18.16	15.99	21.37	18.53	16.66	20.82	18.32	16.25
2. Quality Discrimination	25.69	23.66	21.80	25.03	23.60	21.77	25.41	23.63	21.78
3. Intensity Discrimination	25.04	23.91	22.78	24.99	23.95	22.75	25.02	23.93	22.70
4. Tonal Movement	22.18	17.16	12.35	26.03	21.22	16.33	24.38	18.83	14.19
5. Time Discrimination	21.02	19.33	17.37	20.48	19.00	17.61	20.77	19.19	17.32
6. Rhythm Discrimination	20.73	19.44	17.54	20.90	19.54	18.07	20.81	19.49	17.80
7. Pitch Discrimination	29.75	27.74	25.42	29.36	27.55	25.48	29.57	27.65	25.45
8. Melodic Taste	17.52	15.51	13.77	17.41	15.96	14.13	17.47	15.74	13.91
9. Pitch Imagery	16.24	14.62	13.30	17.26	15.37	13,88	16.83	14.97	13.52
10. Rhythm Imagery	20.13	18.29	16.48	20.94	19.38	17.79	20.53	18.80	17.07
TOTAL SCORE	207.25	195.46	187.54	213.28	202.75	192.65	210.75	198.91	189.00

mational nature. That is to say, the scores made by children approach those made by adults "when the children are old enough to understand the test and sufficiently developed to apply themselves to the task."

SEX DIFFERENCES

The five hundred students who took these tests consisted of two hundred eighty-five men and two hundred fifteen women. The mean, standard deviation, and coefficient of variation of each of the tests and of the total score for the men and for the women are shown in Table 8. On seven of the ten tests, the mean score of the women is higher than that of the men. Three of the differences in favor of the women have critical ratios of 4 or more. These differences occur in Test 4 (Tonal Movement), in Test 9 (Pitch Imagery), and in Test 10 (Rhythm Imagery). The largest difference in favor of the men, found in Test 5 (Time Discrimination), has a critical ratio of 1.94. On the total score the difference in favor of the women has a critical ratio of 5.62.

The sex differences found in the present group of students differ somewhat from those found by Farnsworth (1), who compared the mean scores obtained on the Seashore-Kwalwasser battery by one hundred men and one hundred women students at Stanford University. The superiority of the Stanford women students is statistically significant (or very nearly so) in the Seashore tests of pitch, time, and consonance and in the Kwalwasser test of harmony. In the Seashore test of rhythm, the Stanford men students have a higher mean score than do the Stanford women.

Sex differences in mean scores made on music tests are not confined to adults, however. Kwalwasser (3) has found among 2,500 boys and 2,500 girls that the mean total score of the girls on the Kwalwasser-Dykema tests is superior to that of the boys from grade IV of the elementary school through high school, with the single exception of grade V. On the individual tests, Kwalwasser finds that the girls are significantly

TABLE 8

Differences Between the Scores of the Men and of the Women on the Kwalwasser-Dykema Music Tests

TEST	MEN SUBJECTS (N = 285) Mean	S.D.	C.V.	WOMEN SUBJECTS (N = 215) Mean	S.D.	C.V.	DIFFERENCE BETWEEN MEANS	C.R.[3]	CHANCES IN 100
1. Tonal Memory	18.23 ± .13	3.28	17.97	18.81 ± .15	3.17	16.83	0.58	2.90(W)	97
2. Quality Discrimination	23.60 ± .10	2.62	11.08	23.39 ± .11	2.44	10.44	0.21	1.40(M)	83
3. Intensity Discrimination	23.63 ± .09	2.20	9.29	23.70 ± .09	2.05	8.66	0.07	0.54(W)	64
4. Tonal Movement	17.61 ± .24	6.09	34.57	20.94 ± .26	5.75	27.47	3.33	9.51(W)	100
5. Time Discrimination	18.99 ± .11	2.75	14.45	18.68 ± .12	2.51	13.46	0.31	1.94(M)	91
6. Rhythm Discrimination	19.07 ± .09	2.24	11.75	19.34 ± .10	2.09	10.79	0.27	2.01(W)	91
7. Pitch Discrimination	27.52 ± .13	3.35	12.18	27.15 ± .16	3.39	12.48	0.37	1.76(M)	88
8. Melodic Taste	15.38 ± .11	2.74	17.83	15.60 ± .12	2.56	16.40	0.22	1.38(W)	83
9. Pitch Imagery	15.08 ± .11	2.78	18.40	15.72 ± .12	2.67	16.98	0.64	4.00(W)	100
10. Rhythm Imagery	18.39 ± .10	2.62	14.22	19.26 ± .10	2.22	11.54	0.87	6.21(W)	100
TOTAL SCORE	197.31 ± .61	15.37	7.79	202.54 ± .70	15.10	7.46	5.23	5.62(W)	100

[3] The letter (M) after a critical ratio indicates that the difference is in favor of the men subjects: (W) indicates that the difference is in favor of the women subjects.

superior to the boys in Test 1 (Tonal Memory), Test 4 (Tonal Movement), Test 7 (Pitch Discrimination), Test 8 (Melodic Taste), and Test 9 (Pitch Imagery). The boys tested by Kwalwasser were found to be superior to the girls in Test 2 (Quality Discrimination).

An examination of the standard deviations and coefficients of variation in Table 8 shows that with one exception, Test 7 (Pitch Discrimination), the scores of the men are more variable than are those of the women on the individual tests and on the total score. On Test 7 (Pitch Discrimination), the scores of the women are slightly more variable than are those of the men.

The scores made on music tests, such as the Kwalwasser-Dykema and the Seashore tests, are resultants of compounds of innate musical ability, musical knowledge and other ingredients such as interest and motivation. The proportionate contributions of these factors in a test performance are as yet unknown. It has been pointed out by Kwalwasser (3) that, even though boys and girls possessed the same amount of musical endowment, the present organization and methods of music teaching in the elementary and high schools would still tend to favor the musical education of girls. Kwalwasser recognizes the possibility that girls may be better endowed with musical talent than are boys, but he suggests that differences in interest and motivation as well as differences in musical knowledge must be examined before the innate superiority of girls can be established. In the present study, it will be observed that two of the three tests (tests 9 and 10) in which the women students have a mean score that is significantly superior to that of the men students are tests for which a knowledge of musical notation is presupposed.

While the findings of this study and those of the investigators referred to suggest the possibility of innate sex differences in musical capacity, the drawing of conclusions on this point must await investigations in which such factors as differences in training and in motivation have been controlled.

SUMMARY AND CONCLUSIONS

The Kwalwasser-Dykema Music Tests were given to five hundred college students, sophomores and juniors, consisting of two hundred eighty-five men and two hundred fifteen women. The tests were repeated on a smaller random group of one hundred one students for the purpose of calculating retest coefficients.

The following conclusions seem to be justified:

1. On the individual tests and on the total score, the mean scores of these college students are higher than are those of the school children on whom the tests have been standardized.

2. These college students are somewhat less variable on the individual tests and on the total score than are the children.

3. The retest coefficients range from $r = .0511$ (Intensity Discrimination) to $r = .7268$ (Tonal Memory).

4. The intercorrelations range from zero (Pitch Discrimination and Pitch Imagery) to $r = .3675$ (Tonal Memory and Tonal Movement).

5. Statistically significant differences in mean score in favor of the women students have been found in tests 4, 9, and 10 and in the total score. No difference in mean score in favor of the men students that is statistically significant has been found. The scores of the men are more variable than are those of the women. Any interpretation of these observed differences as evidence of innate sex differences in musical ability must await investigations in which such factors as differences in training and in motivation have been controlled.

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ARE "MUSIC CAPACITY" TESTS MORE IMPORTANT THAN "INTELLIGENCE" TESTS IN THE PREDICTION OF THE SEVERAL TYPES OF MUSIC GRADES?

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THIS paper offers a tentative answer to a problem the writer had set for himself, the task of finding the relative potencies of certain "intelligence" and "music capacity"[1] tests in the prediction of college grades in at least two types of music courses, those in which the academic aspects of music are given chief emphasis, and those in which the tonal elements are more emphasized. The writer was not particularly concerned with the obtaining of a large multiple to be used in predictive work, but rather with the problem of a comparative study of the predictive value of four tests, two of the "intelligence" variety and two of the "music capacity"[1] type.

To date the most extensive series of studies of the use of tests in the prediction of music grades is that excellent one by Stanton[2] at the Eastman School of Music. This series, however, fails to answer the writer's problem in at least four respects. 1. The Eastman School has standards which set it apart from all but a very few of the American colleges which offer music courses. Data gathered at this institution, therefore, might give a rather warped picture of college music in general. 2. As its title indicates, the Eastman School is a college of music, and its grades are earned by music majors. Now it happens that it was not with music grades earned by music majors that

[1] The writer has said at other times and places that he does not believe in the existence of pure music capacity tests. He is employing the term at this time merely because of its general use.

[2] The most recent of H. M. Stanton's reports is "Testing the cumulative key for prognosis of musical achievement," *J. Educ. Psychol.*, 1934, *25*, 45–53.

the present writer wished exclusively to concern himself, but with music grades earned by college students in general. 3. The Stanton data are so described that one can learn merely the *combined* value of the several tests. The findings are expressed in terms of critical levels of achievement and not by means of multiple correlations. The respective rôles of the two sorts of psychological tests, then, cannot be determined. 4. While Stanton divided the Eastman grades according to department—piano, voice, violin, etc., the writer was more interested in a division of grades into such categories as theory, appreciation and history of music, etc. He believed that as courses in history and appreciation are among the more academic and those in theory among the more tonal, one could hardly expect the relative predictive potencies of "intelligence" and "music capacity" tests to be identical in these two dissimilar situations.

The present writer's study[3] employed subjects from the San José (California) State Teachers College whose music courses are undoubtedly more typical of music classes in general than are those of the Eastman School. Of the several thousand music grades chosen at random 359 were kept for further examination. The subjects who earned these grades had taken two intelligence tests, the Thurstone and the Iowa High School Content, and two music capacity tests, the Seashore Sense of Pitch, and the Seashore Tonal Memory. Many were music majors and many were not. No attempt was made to separate these groups.

The courses from which the grades were obtained were divided into (a) history and appreciation of music, the more academic subjects; and (b) theory, the more tonal. It is probable that the grades in theory were somewhat less reliable than those in history and appreciation of music. Two hundred fifty-six grades were assembled from courses in practical

[3] The writer wishes to acknowledge the financial aid he received from a Stanford University grant, a portion of which came from the Laura Spelman Rockefeller Memorial Foundation. He is greatly indebted to various members of the staff of the San José State Teachers College for access to their files.

music (violin, piano, etc.) but were not deemed of sufficient reliability and were discarded.

TABLE 1
History and Appreciation of Music N = 263

Test	*Zero Order r*	*Multiple*	*Grand Multiple*
Thurstone	.41		
		.42	
Iowa	.32		
			.43
Pitch	.14		
		.17	
Memory	.16		

The technique followed with the data reported in the two tables was the well-known Doolittle procedure. Table 1 should be interpreted as follows: There was a coefficient of correlation of .41 between the Thurstone and grades in the history and appreciation of music. There was a multiple correlation of .42 between the two intelligence tests and these same grades, and a grand multiple of .43 between all four tests and the grades, etc. Because of the obvious technical difficulty of obtaining the intercorrelation between the two types of tests the critical difference was not figured. However, no matter what this intercorrelational figure might be it is obvious that the intelligence test multiple is significantly larger than the music capacity multiple.

TABLE 2
Theory N = 96

Test	*Zero Order r*	*Multiple*	*Grand Multiple*
Thurstone	.23		
		.27	
Iowa	.05		
			.38
Pitch	.21		
		.28	
Memory	.25		

Although the writer did not figure the critical difference between the multiples of Table 2 it is quite obvious that the value is not a significant one.

The present findings might seem at first glance to conflict with those recently reported by Chadwick[4] who has said: "In

determining probable success in music, musical talent tests are about two and one-half times as indicative as intelligence tests." But when it is considered that "music" as Chadwick has used it refers to "a very objective performance test" of sight-singing the disagreement at least partially and probably wholly disappears. That is, if music grades of an academic type are to be predicted better by intelligence tests, and theory courses *in general* about equally well by these two sorts of psychological tests, surely the most tonal (sight-singing) will be predicted far better by the music capacity tests.

SUMMARY AND CONCLUSIONS

1. Correlations were run between four psychological tests and what the writer has termed the "more tonal" and "more academic" music grades earned by San José (California) State College students. Two of the tests were of the intelligence variety—the Thurstone and the Iowa Placement, and two were tests of music capacity—Seashore Sense of Pitch and Seashore Tonal Memory. The "more tonal" grades included those in music theory while the "more academic" took in others earned in history and appreciation of music.

2. The two intelligence tests were found to be significantly superior to the two music capacity tests in the prediction of the "more academic" grades from courses in the history and appreciation of music. Neither type of test appeared to be significantly superior in the prediction of the "more tonal" grades from courses in music theory.

3. From the above data one can at least tentatively conclude that music capacity and intelligence tests have variable potencies in the prediction of music grades. It is evident that in courses in which tonal perception and performance are emphasized, the music capacity tests will prove to be better tools of prediction than in those situations in which the academic side is stressed. For the intelligence tests the reverse will be true.

[4] Chadwick, J. E. "Predicting success in sight-singing," *J. Appl. Psychol.*, 1933, *17*, 671–674.

SEX DIFFERENCES IN RATE OF READING IN THE HIGH SCHOOL

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THERE have been many studies of sex differences in ability and achievement, but very few of these studies have dealt with sex differences in speed of reading. One study of the difference between men and women in rate of reading was reported by Berman and Bird[1] in a recent volume of the JOURNAL OF APPLIED PSYCHOLOGY. This investigation was carried on at the college level. It was based on the scores of 642 women and 453 men on the Chapman-Cook Speed of Reading Test. The authors found that the women were consistently superior to the men in speed of reading. They thought that the differences favoring the women were a function of a general language superiority that is manifest from infancy to adult life.

The question of sex differences in rate of reading at the high-school level has apparently not been settled. The question has some practical significance since if large and consistent differences between the sexes are found, it may be desirable to have separate norms for each sex. It is the purpose of this article to report data on the reading rate of several groups of high-school boys and girls.

The Iowa Silent Reading Test, Form A, was given to the Seniors in the University of Chicago High School in October, 1933. Form B of this test was administered to the sub-Freshmen, Freshmen, Sophomores, Juniors, and Seniors in January, 1935. Thus the scores of six classes, consisting of 256 boys and 283 girls, were available. Rate of reading is measured in Part VI of the test. The mean scores of the boys on this part of the test are compared with the mean scores of the girls in each class in Table I.

The table shows that the mean scores made by the boys were slightly ahead of the mean scores made by the girls in the sub-Freshman and Freshman classes and the two Senior classes. The girls had the advantage in the Sophomore class and the means were identical in the Junior class. None of the differences are statistically significant, all of them being less than twice the probable error of the difference.

Neither sex group had an advantage from the standpoint of intelligence. The mean Otis IQ of the boys was 111.5 and the mean Otis IQ of the girls was 111.6.

[1] Isabel R. Berman and Charles Bird, "Sex Differences in Speed of Reading," JOURNAL OF APPLIED PSYCHOLOGY, XVII (1933), 221–26.

TABLE I

Means of the Scores Made on the Rate Part of the Iowa Silent Reading Test by the Boys and by the Girls in Six High School Classes

CLASS	NUMBER OF CASES	MEAN	DIFFERENCE FAVORING BOYS	DIFFERENCE FAVORING GIRLS	P.E. OF DIFFERENCE	DIFFERENCE = ? × P.E.
Sub-Freshmen						
1934–35						
Boys	24	23.8				
Girls	43	21.9	1.9	.....	1.3	1.5
Freshmen						
1934–35						
Boys	47	28.2				
Girls	52	27.6	0.6	.....	1.1	0.5
Sophomores						
1934–35						
Boys	38	27.1				
Girls	44	29.2	.....	2.1	1.2	1.8
Juniors						
1934–35						
Boys	46	30.4				
Girls	38	30.4	0.0	0.0	.....	0.0
Seniors						
1934–35						
Boys	54	31.5				
Girls	62	31.2	0.3	.....	0.9	0.3
Seniors						
1933–34						
Boys	47	30.9				
Girls	44	28.8	2.1	.....	1.1	1.9

The conclusion indicated by the data is that boys and girls, as groups, read at equal rates throughout the high school. Girls may possess, as some studies have indicated, a general language superiority over boys, but there is no evidence that this superiority, if it exists, influences the relative reading rates of girls and boys at the high-school level.

NOTES AND NEWS

A new publication, "International Journal of Individual Psychology," with Dr. Alfred Adler as Editor-in-Chief, is announced by International Publications, of Chicago. The Journal is in the nature of an English counterpart of the "International Zeitschrift for Individualpsychologie," a German publication which Dr. Adler and his associates have issued in Vienna since 1913. The initial number contains twelve articles, all by authoritative exponents of the Adlerian school, among which are: "What is Neurosis?" by Dr. Adler; "Bronchial Asthma as a Neurotic Symptom" by Arthur Holub; "Homosexuality as Neurosis" by Edwin O. Krausz; "Development of Character" by Ferdinand Birnbaum; and others. The fact that Dr. Adler is now occupying the chair of Medical Psychology at Long Island Medical College, and that he has already taken first steps toward becoming an American citizen, together with the migration to the United States of other leading Individual Psychologists, bids fair to transplant the center of this new Psychology from Vienna to the United States.

The Library of Congress in Washington recently announced a new service which makes available to anyone any material in the Library of Congress in the form of outlines, typewritten copies, summaries, or actual photostatic copies of the original. At various times students, researchers, professors, historians, writers and others are obliged to undertake extensive research in magazines, newspapers and books, of all types and of all periods in the history of the country. In order to be of assistance to non-resident researchers a service is now available by which material and data can be assembled and sent anywhere in the country. Inquiries for further information regarding this service may be addressed to Laurence E. Tomlinson, Library of Congress, Washington, D. C.

The Education Division of the National Safety Council, New York, has recently published "The Junior Safety Council: A Handbook for the Schools," to assist principals and teachers who have had no experience with a safety program, experienced teachers who are seeking new ideas, and students responsible for the administration of an activity, a committee or an entire organization. It tells how to organize a Council and how to conduct interesting programs and special activities. Special chapters are devoted to the operation of patrols at street intersections, on the school grounds, on school buses, as well as a set-up for the safety court. Forms for accident reporting, home inspection and suggested constitutions for the Junior Safety Council and Home Room Safety Club are included. The price of this Handbook is 35 cents.

BOOK REVIEWS

GARDINER, GLENN L. *How You Can Get a Job.* New York: Harper and Brothers. 1934. Pp. 188.

Getting a job *is* a job, and Glenn Gardiner tells in his most recent book just how you can be the most efficient and productive when you are thus "working for yourself." In the course of answering 197 questions that are hypothetically posed by the inquisitive reader who is out looking for a job, the author sets forth a systematic plan for a job-getting campaign. He advises as to what job to seek, where to look, whose help to secure, what preparation to make for interviews, how to behave and what to say during the interview, how to follow up job prospects, how to make use of letters, and what to do with spare time.

Included in the discussion of what work one is best qualified to do is a series of questions for an inventory of one's own personality traits. A conscientious consideration of them is intended to help determine whether one is better fitted for such work as that of accountant, mechanic, chemist, or designer, or the work typical of the teacher, salesman, lawyer, or merchant. In another part of the book are found sample application letters, follow-up letters, and letters of introduction and recommendation.

The down-and-out man who reads this book is more than likely to "get a lift." He will get a new attitude toward the whole "business" of job hunting, and will discover how he can regain self-respect and the respect of others if he is willing to be systematic and thorough in his effort to sell himself and his abilities to prospective "buyers."

KATHERINE A. PRESTON,
Vineland, N. J.

COX, J. W. *Manual Skill.* Cambridge: at the University Press; New York: the Macmillan Company. 1934. Pp. vii + 247.

There are two reasons at least for stressing the importance of this book. First, because of the practical application of knowledge of manual skill in industry and education and, second, because the subject of manual skill is interesting from a psychological point of view owing to the close relationship between manual and mental development.

The manual operations discussed in this study are those involved in manipulation and adjustment of objects to one another.

The content of this book is essentially a report of the experiments carried out by the author. In the beginning, reference is made to previous research on manual skill by other investigators. However, since

the author is a member of what might be called the Spearman school, his approach to the measurement and analysis of manual skill differs somewhat from that of previous investigators.

His treatment of the subject entails, first, the problem of its measurement; second, the nature of factors which underly its organization; third, an inquiry as to which are the best conditions for its development.

In the measurement of assembling operations, objective scores, introspections and observations of individuals are all taken into consideration.

Some nearly revolutionary findings were derived from the intercorrelational studies, *e.g.*, that the popular grouping of abilities into "general," "mechanical" and "manual" abilities is not quite justified because these "abilities" are interrelated.

By the use of Spearman's method of tetrad differences and Yule's method of partial correlation, the activities measured were analyzed into their underlying factors. A factor is defined as being "an underlying influence, or cause, which partly determines ability but which, unlike an 'ability,' functions as a unitary whole and in independence of other factors." By this analysis, the existence of the following factors was shown: (1) a general factor, (2) a mechanical factor, (3) a routine manual factor, (4) two small additional factors each restricted to a pair of the simple manual tests involving closely similar movements. The analysis also disclosed a factor peculiar to each operation, *i.e.*, one which enters into no other operation.

The significance of the analysis for psychological theory is that it supports none of the three conventional theories in their extreme form, but partially supports each. The general factor is like the single trait, *e.g.*, "intelligence," but it does not operate alone. With it are the group factors, somewhat like the "faculties" in their broad scope, the view presented in the second theory. Each specific factor peculiar to a particular activity is comparable to one of the independent, psychological elements of the third theory.

In a section devoted to the development of manual skill, the results show that skill developed by "training" has a tendency to transfer, while skill developed by "practice" fails to transfer.

In dealing with the analysis of psychological processes underlying mechanical assembling the author follows Spearman closely. The questions examined here have a close relation to some of the problems of Gestaltpsychologie.

This book makes an excellent contribution to our knowledge of the factors involved in manual skill. It will be a valuable book for supplementary reading for advanced students in industrial psychology.

K. W. Oberlin,
University of Delaware, Newark, Delaware.

SORANTIN, ERICH. *The Problem of Musical Expression.* Nashville: Marshall & Bruce. 1932. Pp. 128.

This book is an important contribution to the analysis of meaning in music. The first chapter presents a detailed review of the old controversy between Wagner and Hanslick of whether music is capable of expressing more or less definite emotional states, or if it has no meaning other than that gratuitously given by the present mood of the listener. The next three chapters consider the theories and views of various philosophers on the expressibility of music, the method used in the author's study, and a discussion of the theory of feeling and emotion. The author then takes up the old problem and by an analysis of approximately 240 classical compositions attempts to find if there are certain musical figures which can express definite emotional states. The burden of proof rests entirely upon the similarity of the forms (figures) employed by different composers who admittedly intended, by the title of the composition, to portray a specific mood or emotional state to the listener.

Four main melodic expressive figures were found which are in common use by classical composers—grief, joy, longing, and love. Grief is characterized by the descending minor second, usually preceded by an introductory ascending interval, and accompanied by alternating crescendo-descrendo intensities (p. 41). Legato phrasing and slow tempo are minor supporting characteristics. Joy is expressed by extensive use of the interval of the fourth, major tonality, simple harmonies, and a melody progressing towards a definite note as a goal. This pattern can be reenforced by the use of accelerated tempo. Intense joy or ectasy may be simulated by the additional use of long thrills. The interval of the seventh is the important factor producing the emotion of longing. If there is a possibility of achieving the object longed for, the interval of the seventh is interwoven with the figure of joy; if it seems to be impossible to obtain the object longed for, the interval of the seventh is found in conjunction with the gestalt of grief. The pattern of love is very similar to that of joy only it is more complex. It has the added elements of the interval of the sixth, a wavy S-shaped melodic line, oscillation between major and minor tonality, moderated tempo, legato phrasing, and occasionally the introduction of the figure of longing.

Although the method has been entirely analytical and there is no experimental proof that these figures do produce the emotional set anticipated in all listeners, yet anyone who is familiar with music would not deny that such a correspondence exists. It will be noticed that there is an overlapping in the figures of joy and love and between grief and longing. This leaves two distinctive patterns corresponding to the only two patterns so far discovered by the experimental work in emotion. These two

patterns have long been recognized in music; major tonality depicts joy, while minor tonality expresses sadness.

A further analysis is made of rhythmical patterns of which four main kinds are found: pendular motion, circular motion, downward motion, and persistency. These figures represent such acts as the rustling of trees, spinning or cradle songs, dying, and quiescence.

The book is written from the musicians' viewpoint and the validity of the conclusions depend upon the author's selection of examples, but since the sampling is so large—240 musical selections—no great sampling error is likely. The author has made a good analysis and the conclusions now need to be checked by the experimental method using a large group of *musical* subjects.

RALEIGH M. DRAKE,
Wesleyan College, Macon, Ga.

CAMPBELL, C. MACFIE. *Human Personality and the Environment.* New York: Macmillan. 1934. Pp. 252.

The author, in his preface to this little volume containing the substance of six lectures delivered before a lay audience in Boston, has himself reviewed the book fairly and impartially. A series of lectures to laymen could hardly have been more technical, and while the professional psychologist would have wished for a more precise formulation of principles and supporting evidence, "the impatient desire for a unitary formulation may lead him to lay undue emphasis on one or other rigid formulation . . . to the exclusion of other aspects of the total facts of being."

The lectures deal successively with food, oxygen and other basic supplies as they affect temperament; the glands, the autonomic system and the optic thalamus, structures intimately related to emotional life; genetics, and other basic physical factors. From genes and chromosomes Campbell shifts almost unnoticed into a discussion of childhood conditioning; from this point the book summarizes in a very readable and yet accurate way our knowledge and theoretical interpretation of the social development of personality.

The lecture style contributes enjoyable bits of humor such as the fun poked at over-enthusiastic analysts by Sir William Osler. Osler is quoted to this effect: "The Pediatrics Society discourages bottle feeding of babies because . . . it is clearly shown that intellectual obliquity, moral perversion and special crankiness of all kinds result directly from the . . . gross and unworthy deception to which (the child) is subjected . . ." We could wish that a similar verbal spanking had been administered to the endocrinologists, some of whose extremest fulminations on the subject of personality are quoted without posting signs reading "Danger!"

The lecture style may also have contributed to an occasional use of dubious terminology; for instance, the term "instinctive" is occasionally applied incautiously to activities which are plainly learned.

The last two lectures, "The personality and some of its tasks" and "The personality and the total situation" are excellent treatments of the psychiatric approach to the substitutive mechanisms of personality and its manipulation of reality in quest of self-expression.

The reviewer recommends it to laymen with some knowledge of biology, and to students desiring a first introduction to the complex fields grouped as "personality." He would also suggest a use which Dr. Campbell may consider a perversion, viz., as required reading at the end of an elementary psychology course. So many teachers (and textbooks) plaster on the student a patch relating to sensations, one about glands, another on emotions, and leave the personality (and psychology) as a mere patchwork without integration, that a book of this sort has great possibilities. The style is so lucid that the reading would put few strains even on the intellectual endowment of college sophomores.

ROSS STAGNER,
People's Junior College, Chicago, Illinois.

NEW BOOKS AND PAMPHLETS RECEIVED

Books and pamphlets for review should be sent to James P. Porter, Editor, Journal of Applied Psychology, Ohio University, Athens, Ohio.

Ability and Opportunity in English Education. J. L. GRAY AND PEARL MOSHINSKY. *The Sociological Review,* XXVII, No. 2, April 1935. La Play House Press, 35 Garden Square, London, England.

Child Psychiatry. LEO KANNER. CHARLES C. THOMAS, Baltimore, Md., 1935. $6.00. 527 pp.

The Construction and Validation of a Group Test of Intelligence Using the Spearman Technique. C. EBBLEWHITE SMITH. Department of Educational Research, Ontario College of Education, 371 Bloor St., W., Toronto, Canada. 50 cents. 56 pp.

Dare to Live. GERALD BREITIGAM. McGraw-Hill Book Company, New York, 1935. $2.00. 229 pp.

Definition Vocabulary. MICHAEL WEST. University of Toronto, Toronto, Canada, 1935. $1.00. 105 pp.

Educational Psychology. ALVIN C. EURICH AND HERBERT A. CARROLL. D. C. Heath & Company, New York, 1935. $2.24. 436 pp.

Educational Psychology. J. B. STROUD. Macmillan Company, New York, 1935. $2.50. 490 pp.

Evidence for Two Opposed Processes in Mental Growth. GEORGE S. SNODDY. Science Press Printing Company, Lancaster, Pa., 1935. 103 pp.

The Foundations of Human Nature. JOHN MORRIS DORSEY. Longmans, Green & Company, New York, 1935. $2.80. 488 pp.

General Psychology. GARDNER MURPHY. Harper & Brothers, New York, 1935. $2.50. 572 pp.

A Handbook of Literary Use. MERRILL T. EATON AND C. M. LOUTTIT. *Educational Progress Bulletin,* Vol. 11, No. 1, March 1935. Houghton Mifflin Company, New York, 1935. 20 cents. 43 pp.

A Modern Book of Esthetics: An Anthology. MELVIN M. RADER, Editor. Henry Holt & Company, New York, 1935. $2.60. 504 pp.

Personality Adjustment and Domestic Discord. HARRIET R. MOWRER. American Book Company, 1935. 290 pp.

Principles of Gestalt Psychology. KURT KOFFKA. Harcourt, Brace & Company, New York, 1935. $5.00. 720 pp.

The Social Worker in the Prevention and Treatment of Delinquency. MARGARETTA WILLIAMSON. Columbia University Press, New York, 1935. $2.50. 236 pp.

The Validation of Test Items. JOHN A. LONG AND PETER SANDIFORD. Department of Educational Research, University of Toronto, 1935. $1.00. 126 pp.

Visual Outline of Psychology. KATE HEVNER. Longmans, Green & Company, New York, 1935. 95 pp.

A Vocational Guidance Research in Fife. F. M. EARLE AND J. KELGOUR. National Institute of Industrial Psychology. Aldwych House, WC2, London, England. Price 4s. 6d. 101 pp.

Wish-Hunting in the Unconscious. MILTON HARRINGTON. Macmillan Company, New York, 1934. $2.50. 189 pp.

Directory of American Psychological Periodicals

(Continued)

Comparative Psychology Monographs—Baltimore: Johns Hopkins University Press. Subscription $5. 400 pages per volume. Knight Dunlap, Managing Editor. Published without fixed dates, each number a single research. Founded 1922.

Genetic Psychology Monographs—Worcester, Mass.: Clark University Press. Subscription $7.00 per volume. One volume per year. Edited by Carl Murchison. Bi-monthly. Each number one complete research. Child behavior, animal behavior and comparative psychology. Founded 1925.

Psychological Abstracts—Eno Hall, Princeton, N. J. American Psychological Association. Subscription $6.00. 700 pages ann. Edited by W. S. Hunter and G. R. Willoughby. Monthly. Abstracts of psychological literature. Founded 1927.

Pedagogical Seminary and Journal of Genetic Psychology—Worcester, Mass.: Clark University Press. Subscription $14.00 per annum; $7.00 per volume. 1,000 pages annually (2 volumes). Edited by Carl Murchison and an international cooperating board. Quarterly. Child behavior, animal behavior, and comparative psychology. Founded 1891.

Journal of Social Psychology—Worcester, Mass.: Clark University Press. Subscription $7.00. 500-600 pages annually. Edited by John Dewey and Carl Murchison. Quarterly. Political, racial, and differential psychology. Founded 1929.

Personnel Journal—Baltimore: The Williams & Wilkins Co. Subscription $5.00. 500 pages, approximately. Edited by Walter V. Bingham. Bi-Monthly.

Mental Measurement Monographs—Baltimore: The Williams & Wilkins Company. Subscription $5. 400 pages annually. Edited by Knight Dunlap and Buford Johnson. Published without fixed dates, each number a single research. Founded 1916.

Studies in Psychology and Psychiatry—Baltimore: The Williams & Wilkins Company. Subscription $5.00. 400 pages annually. Edited by Edward A. Pace. Published without fixed dates, each number a single research. Founded 1926.

Journal of Educational Psychology—Baltimore, Md.: Warwick & York. Subscription $6.00. Edited by Jack W. Dunlap, Harold E. Jones, and Percival M. Symonds. Published monthly except June to August. Founded 1910.

Child Development—Baltimore, Md.: Williams & Wilkins Company. Subscription $6.00. 400 pages annually. Edited by Buford Johnson. Quarterly. Founded 1930.

Character and Personality—Durham, N. C.: Duke University Press. Subscription $2.00 per annum. Quarterly. Edited by Robert Saudek (London) and Ernest Seeman (Durham, N. C.). Founded 1932.

The Psychological Exchange—11 East 125th Street, New York, N. Y. Subscription $3.00 per annum. Bi-monthly. Edited by James Hargan. Founded 1932.

Directory of American Psychological Periodicals

American Journal of Psychology—Ithaca, N. Y.: Cornell University. Subscription $3.50. 624 pages annually. Edited by M. F. Washburn, K. M. Dallenbach, M. Bentley, E. G. Boring. Quarterly. General and experimental psychology. Founded 1887.

Journal of General Psychology—Worcester, Mass.: Clark University Press. Subscription $14.00 per annum; $7.00 per volume. 1,000 pages annually (2 volumes). Edited by Carl Murchison and an international cooperating board. Quarterly. Experimental, theoretical, clinical, and historical psychology. Founded 1928.

Psychological Review—Princeton, N. J.: Psychological Review Company. Subscription $5.50. 540 pages annually. Bi-monthly. General Psychology. Edited by Herbert S. Langfeld. Founded 1894.

Psychological Monograph—Princeton, N. J.: Psychological Review Company. Subscription $6.00 per vol. 500 pp. Ed. by Joseph Peterson. Published without fixed dates, each issue one or more researches. Founded 1895.

Psychological Index—Princeton, N. J.: Psychological Review Company. Subscription $4.00. 300–400 pp. Edited by W. S. Hunter and R. R. Willoughby. An annual bibliography of psychological literature. Founded 1895.

Psychological Bulletin—Princeton, N. J.: Psychological Review Company. Subscription $6.00. 720 pages annually. Psychological literature. Monthly (10 numbers). Edited by John A. McGeoch. Founded 1904.

Archives of Psychology—New York: Columbia University.
Subscription $4. 500 pp. ann. Ed. by R. S. Woodworth. Published without fixed dates, each number a single experimental study. Founded 1906.

Journal of Abnormal and Social Psychology—Eno Hall, Princeton, N. J.: American Psychological Association. Subscription $5. Foreign, $5.25. Editor, Henry T. Moore. Quarterly. 448 pages annually. Abnormal and Social. Founded 1906.

Psychological Clinic—Philadelphia: Psychological Clinic Press.
Subscription $3.00. 280 pages. Ed. by Lightner Witmer. Without fixed dates (Quarterly). Orthogenics, psychology, hygiene. Founded 1907.

Psychoanalytic Review—Washington, D. C.: 3617 19th St., N. W.
Subscription $6. 500 pages annually. Psychoanalysis. Quarterly. Ed. by W. A. White and S. E. Jelliffe. Founded 1913.

Journal of Experimental Psychology—Princeton, N. J.: Psychological Review Company. 500 pages annually. Experimental. Subscription $7.00. Bi-monthly. Edited by S. W. Fernberger. Founded 1916.

Journal of Applied Psychology—Lancaster, Pa.: Science Press Printing Co. Subscription $6.00. 500 pages annually. Bi-monthly. Edited by James P. Porter, Ohio University, Athens, Ohio. Founded 1917.

Journal of Comparative Psychology—Baltimore: The Williams & Wilkins Co. Subscription $5.00 per volume of 450 pages. Two volumes every year. Edited by Knight Dunlap and Robert M. Yerkes. Founded 1921.

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